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In cooperation with the University of Wisconsin

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LONGLEAF PINE: COSTS AND RETURNS FOR LOGS AND TREES OF DIFFERENT SIZES

By R. D. GARVER, Senior Forester
and
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INTRODUCTION

This report contains facts and figures resulting from a logging and milling study carried out by the Forest Service at a large sawmill cutting typical virgin-growth longleaf pine. It is estimated that the present longleaf-slash pine type covers some 11 million acres about one-third of which is virgin timber. On medium to good sites longleaf pine has the ability to reproduce itself and increase its growth rate in a satisfactory manner under partial cutting. The chief purpose of the study was to determine for virgin longleaf pine stands the production cost and value of lumber from trees of different diameters for use in establishing cutting limits (1) where only one cut is planned and (2) where the stands are to be logged selectively with the idea of a return cut in a few years. In addition, information on percentage of defect, overrun, log grades, and utilization practices was obtained.

Selective logging or selective cutting as used in this report means a partial cutting practice which removes the large mature trees and defective smaller ones and leaves the small and medium-sized trees for future growth and seed production. Selective logging applies well-established forestry principles to lumbering and bears directly on cost reduction and the development of permanent operations. Costs and lumber prices vary with economic conditions but their relationship to each other among the different diameter classes remains fairly constant, and the minimum diameter cutting limits are not materially affected if the proportionate increase or decrease is about the same for each.

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[1]Acknowledgment is made to E. L. Demmon and H. G. Meginnis of the Southern Forest Experiment Station for assistance in the field work, to A. C. Wollin of the Forest Products Laboratory for assistance in the field and office computation, and to officers and employees of the Great Southern Lumber Company, especially P. M. Garrison, Forester, for their cooperation in the investigation.

A. Young timber mixed with virgin growth.

B. Typical virgin longleaf pine.

C. Study area after logging. Small trees and fairly clear tops and limbs were utilized for pulpwood.

AREA STUDIED

The area studied is located in east-central Louisiana and contains about 22 acres. It is rectangular in shape, includes a small draw, a low ridge, and in general its topography is characteristic of the type associated with longleaf pine. (Plate 1) The stand on the area was typical virgin longleaf pine in which most of the trees were more than a century old with some as much as 300 years old, but as usual there were a few patches of young timber scattered among the veterans. The trees varied from 6 inches to 33 inches in diameter and trees 9 inches and larger yielded 13,137 board feet lumber tally per acre. The largest volume occurred in the 22-inch diameter class. The few trees below 9 inches in diameter were mostly broken down in logging. Table 1 gives the volume distribution of the cut among the different diameter classes. The dominant old trees averaged 198 years old. Their crowns were flat and it was evident that they had reached maturity some time ago. The rate of growth of this mature timber was extremely slow and decay was on the increase. The young timber averaged 76 years of age and was growing at a fairly good rate. There was practically no advanced reproduction. Scarred and burned butts on the timber indicated that fire had run repeatedly over the area.

The stand had been turpentined for two years previous to the study. Most of the large trees had two faces about 40 inches in length. The faces were not wormy and the turpentining evidently had no connection with the rot that was prevalent in the stands.

LOGGING AND MILLING

The trees were felled (Plate 2, C) and bucked into long lengths suitable either for the production of timbers or for additional cross cutting at the mill into standard log lengths for lumber production.

Skidding was done with a four-line power skidder.(Plate 2, B) Spurs were placed 1,000 to 1,200 feet apart, so that the skidder lines reached out a maximum of 500 to 600 feet on each side of the track.

Logs were loaded with a swinging boom loader into flat cars and hauled by a rod engine over a standard gauge railroad 16 miles to the mill. (Plate 2, A)

The logs were sawed into lumber or squared for timbers by a single band mill. The No. 2 Common and Better boards were kiln dried and the No. 3 Common and No. 4 Common were air seasoned. Dimension below No. 1 Common was also air seasoned. Timbers were soda dipped or sprayed. Lumber and timbers were cut for both export and domestic markets and sold either rough, surfaced, or patterned.

A. Loading long and short logs with equal facility, this loader loads 50 to 60 cars per day.

B. Four-line power skidder which brings about 250 thousand feet of logs per day to the track.

C. Felling and bucking were done by a crew of two men.

Table 1.--Volume distribution of virgin longleaf pine trees as cut by diameters on a gross-log scale and lumber tally basis in southern Louisiana

Diameter breast high	Volume distribution	
	Gross log scale	Lumber tally
Inches	Per cent	Per cent
9	0.1	0.2
10	.3	.5
11	.6	.9
12	.9	1.3
13	1.3	1.7
14	1.8	2.2
15	2.4	2.8
16	3.2	3.6
17	4.2	4.6
18	5.4	5.7
19	6.9	7.1
20	8.6	8.7
21	10.5	10.4
22	11.0	10.7
23	10.3	9.9
24	8.5	8.0
25	6.9	6.4
26	5.3	4.9
27	4.0	3.6
28	2.9	2.6
29	2.1	1.8
30	1.4	1.2
31	.9	.8
32	.4	.3
33	.1	.1

METHODS OF STUDY

The study area was bisected by a spur track. All logging was carried on during the study in the usual way and the results obtained should be representative of normal practice. The study crew worked in the woods from the time the first tree was felled until the time the last log was loaded on cars ready for hauling to the mill. As each tree was felled and bucked into logs the time for each operation and detailed measurements for each tree and log were recorded. Since the bole of the tree was crosscut into lengths varying from 12 to 70 feet, it was not practicable to scale accurately the timber in the woods. The logs were therefore numbered for identification purposes and the actual scaling was done at the mill after the tree lengths had been cut into log lengths. The Doyle log rule was used. Production costs for felling were computed on the basis of the time consumed, amount of timber cut, and the rate of pay per unit of time as determined from the earnings of the men who were paid on a per thousand foot basis. Such a procedure allots to each tree size its proportion of the cost as determined from the time consumed in cutting it and shows that felling and bucking costs per M are higher for small trees than for large ones.

For skidding, the time, distance traveled, and the number were recorded for each log. All four lines of the skidder were handled simultaneously by four men. For loading, the time consumed and the number on each log were recorded. These data, when completed by adding the scale of each log as determined at the mill, were combined with the daily cost of the skidder and loader in computing the cost of the different operations by log and tree sizes.

The cost of hauling the timber to the mill obviously could not be determined from time records, so that it was computed for logs of different sizes on the basis of the cost of a car trip and the various board-foot capacities of a standard car when loaded entirely with logs of one size. The cost of hauling per car was considered constant. Therefore, the hauling cost for 10-inch logs would be about twice as much per M as for 24-inch logs, because the log scale volume of a car of 10-inch logs was only about one-half that of a car loaded with 24-inch logs.

Unloading costs were based directly on the wages of the men and the volume handled, and were varied for logs and trees of different sizes on the basis of the time ratios for the headsaw in the mill.

At the mill the study crew was stationed at various points so that complete log scale records, sawing time, method of sawing, amount and grade of lumber were obtained separately for each log. The lumber and timbers were graded according to the rules of the Southern Pine Association considering both domestic and export grades.

Milling costs were computed from the actual time required to produce a thousand board feet of lumber and timber from logs of different sizes and the cost of running the mill for that period.

Kiln, yard, shed, loading, and shipping, and other costs of a like nature were obtained direct from the company and were considered as varying among the different sizes of logs according to the amount of lumber from each log handled and in the same ratio as the number of pieces of lumber per thousand board feet cut from the different sized logs and trees.

Planing mill costs were considered constant. Although this item varies according to the size of the boards, there are so many other undeterminable variables entering into this cost that it was thought best to handle this item as a constant. No doubt planing mill costs would be higher for small trees than for large ones.

Selling costs were considered constant because some lumber was sold on commission and some by a sales force. The selling cost of the lumber disposed of by the sales force would vary as the output of the headsaw, whereas commission selling costs would vary with the price of the lumber or just the opposite, which would tend to offset the above effect and make the average selling cost constant.

Taxes and insurance on lumber and discounts were computed from the company's average cost and the price of the lumber for the different diameter classes of logs and trees.

Such costs as spurs, roads, and camp construction were handled as fixed charges per acre and under such conditions the cost per thousand board feet varies inversely with the amount of timber removed per acre. For example, if the stand runs 10 M per acre and the railroad construction costs amount to $20, then if all the timber was cut the cost would be $2 per M but if only half of it was cut under selective logging the cost would be $4 per M.

The tables on production costs which follow explain in detail how each item was treated and should be taken into account in considering the production costs for trees of different diameters.

The change in grade and amount of lumber lost in remanufacture that takes place between the green chain and the car was determined by marking the grade on a part of the cut, then tallying and grading it again after it had passed through the kilns and planer. The correction factor obtained in this way was used to convert the green-chain tally to a dry-lumber basis.

Lumber and timber prices were obtained directly from the company and represent the average for 1930. The value of the lumber and timbers for each size of tree and log was computed on the basis of a piece tally, corrected for drying and planer changes and the appropriate lumber price.

The log run lumber and production cost and the results if a stand were cut to different minimum diameter limits were computed using the volume distribution among the different diameter classes as found during this study.

The same timber was studied in the mill as in the woods and the results for trees were obtained by adding together the information for the logs that made up each tree.

The tract contained 726 virgin longleafpine trees which were cut into 1,909 logs that yielded 226,094 board feet log scale and 275,609 feet board measure. The tract was clear cut, taking all trees 9 inches and larger in order to obtain information on the complete range of diameter classes.

USE OF RESULTS

A knowledge of costs and returns for logs and trees of different sizes may be used either to reduce production costs and increase returns in clear cutting operations by leaving the unprofitable trees uncut or to develop selective logging plans with permanent operation in mind. The figures given here are for a typical lumber and timber operation and have their closest application in similar cases when it is desired to compute cutting limits or the returns from trees or logs of various sizes. The information is of use to the lumberman who owns only the timber and wishes to establish a cutting practice that will bring in the highest return per acre without regard to another cut and also to the operator who plans on a return cut within a reasonable time and desires to set up a cutting policy that will separate the timber into that which should be cut now and that which should be left for harvesting at some future time.

TREE AND LOG SIZES IN RELATION TO COSTS AND RETURNS

Lumber production costs and values are computed in the commercial operation on the basis of log-run results. Just what the results would be if a portion of the timber were left out of the cut is generally not known. Small trees are in most cases handled at a loss and some medium-sized trees do not yield a satisfactory profit considering stumpage and other charges. For close figuring and efficient operation a knowledge of costs and tree values by diameter classes is desirable. Every experienced lumberman knows that small trees are less profitable to handle than large trees from the same stand, but the exact difference and the smallest size that yields a satisfactory profit is not known.

The next several tables give information on costs and returns for trees and logs of different sizes and present the economic side of selective logging and some of the possibilities when consideration is given to the removal of the stand by selective logging rather than clear cutting.

The cost classification is explained by footnotes on each table. Interest on invested capital, federal income tax, and stumpage have not been included in these costs.

LOGGING COSTS FOR LONGLEAF PINE TREES OF DIFFERENT SIZES

There was less manual labor used in logging at the operation studied than at operations in which animal skidding and hauling are used and logs are cut to length in the woods by the felling crews. Nevertheless the costs in handling trees of different sizes follow similar trends. At the operation studied the total logging costs per M board feet log scale for 10-inch trees were 4.7 times greater than for 24-inch trees. In an animal logged, short-log, shortleaf pine operation in eastern Texas the ratio for similar sized trees was 3.1. These ratios would seem to indicate that handling small timber by power is comparatively more costly than handling the same material by animal logging.

An analysis of the data in Table 2 shows that the average felling and bucking cost for 10-inch longleaf pine trees was 4.2 times greater than for 24-inch trees; for skidding the ratio was 14.0; for loading 11.4; and for railroad transportation 2.9. These figures indicate that the comparative costs of loading and skidding small trees are excessively high as compared with felling and that these two items merit especially close attention in an analysis of logging costs, particularly if handling timber on which the margin is close. These ratios are reduced considerably when the costs are converted to a lumber tally basis by the use of overrun figures as will be explained later in this report.

LOGGING COSTS FOR LONGLEAF PINE LOGS OF DIFFERENT SIZES

Table 3 gives the logging costs for longleaf pine logs of different sizes. The table is based on the logs that resulted after the final cross-cutting at the mill. In general the ratios of costs for different sizes follow closely the trends for trees shown by the figures in Table 2. Skidding costs show the highest ratio as between small and large logs with the other items following in about the same order as for trees. (Plate 2, A and B)

Table 2.--Logging costs[1] per thousand board feet, gross log scale and lumber tally, for virgin longleaf pine trees

Cost item	Classification of costs[2]	Weighted average cost per M bd. ft. gross log scale	Itemized costs per M board feet, gross log scale, for the indicated diameter breast high in inches																								
			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Felling - labor, supplies, other charges	VT	0.82	4.28	2.86	2.20	1.84	1.60	1.40	1.23	1.09	0.98	0.91	0.83	0.78	0.74	0.70	0.69	0.68	0.68	0.68	0.68	0.69	0.70	0.72	0.73	0.75	0.78
Skidding - labor, cables, fuel, supplies, repairs	VT	1.28	15.13	11.07	7.01	4.90	4.06	3.43	2.85	2.32	1.90	1.63	1.37	1.21	1.05	0.95	0.84	0.79	0.74	0.69	0.63	0.58	0.53	0.47	0.42	0.37	0.34
Loading - labor, cables, fuel, supplies, repairs	VT	0.32	3.28	2.29	1.63	1.20	0.93	0.76	0.66	0.56	0.48	0.41	0.36	0.31	0.27	0.24	0.22	0.20	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.15	0.14
Spurs - labor, ties, supplies	CA	1.00																									
Reserve for moving railroad and camp	CA	0.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
Railroad maintenance, miscellaneous camp expenses	VMT	0.44	1.30	1.04	0.90	0.82	0.76	0.71	0.66	0.62	0.58	0.54	0.49	0.46	0.42	0.40	0.38	0.37	0.35	0.33	0.32	0.30	0.29	0.27	0.26	0.25	0.23
Railroad transportation, train labor, fuel, supplies, repairs, wheelage	V Cap	1.21	3.87	3.04	2.56	2.25	2.01	1.82	1.67	1.54	1.43	1.34	1.27	1.21	1.16	1.12	1.09	1.06	1.04	1.03	1.01	1.00	0.98	0.97	0.96	0.95	0.94
Total logging cost per M board feet gross log scale		5.63	29.42	21.86	15.86	12.57	10.92	9.68	8.63	7.69	6.93	6.39	5.88	5.53	5.20	4.97	4.78	4.66	4.56	4.47	4.38	4.30	4.23	4.15	4.09	4.03	3.99
Total logging cost per M board feet lumber tally		4.62	11.79	10.86	8.93	7.72	7.17	6.69	6.22	5.75	5.33	5.02	4.71	4.49	4.29	4.16	4.04	3.98	3.93	3.89	3.84	3.81	3.78	3.73	3.71	3.69	3.69

Table 3.--Logging costs[1] per thousand board feet, gross log scale and lumber tally, for virgin longleaf pine logs

Cost item	Classification of costs[2]	Weighted average cost per M bd. ft., gross log scale	Itemized costs per thousand board feet, gross log scale, for the indicated diameter inside bark at the small end in inches																								
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27			
		Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars			
Felling - labor, supplies, other charges	VT	0.82	5.66	3.52	2.42	1.85	1.51	1.26	1.06	0.91	0.81	0.74	0.69	0.65	0.63	0.60	0.60	0.62	0.64	0.65	0.68	0.72	0.75	0.79			
Skidding - labor, cables, fuel, supplies, repairs	VT	1.28	26.58	15.39	9.43	6.01	4.01	2.79	2.06	1.58	1.26	1.05	0.90	0.74	0.69	0.63	0.58	0.53	0.47	0.42	0.40	0.37	0.34	0.32			
Loading - labor, cables, fuel, supplies, repairs	VT	0.32	6.36	3.33	1.91	1.21	0.84	0.65	0.51	0.41	0.33	0.28	0.23	0.20	0.18	0.17	0.15	0.15	0.14	0.14	0.14	0.13	0.13	0.13			
Spurs - labor, ties, supplies	CA	1.00																									
Reserve for moving railroad and camp	CA	0.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56			
Railroad maintenance, miscellaneous camp expense	VMT	0.44	2.90	1.75	1.14	0.87	0.72	0.64	0.58	0.52	0.48	0.43	0.39	0.37	0.34	0.32	0.31	0.31	0.29	0.29	0.29	0.28	0.28	0.27			
Railroad transportation, train labor, fuel, supplies, repairs, wheelage	V Oap	1.21	7.81	4.17	2.87	2.22	1.82	1.56	1.39	1.28	1.20	1.14	1.08	1.04	1.01	0.98	0.96	0.94	0.92	0.90	0.88	0.86	0.85	0.83			
Total logging cost per M board feet gross log scale		5.63	51.17	29.72	19.33	13.72	10.46	8.46	7.16	6.26	5.64	5.20	4.85	4.56	4.41	4.26	4.16	4.11	4.02	3.96	3.95	3.92	3.91	3.90			
Total logging cost per M board feet lumber tally		4.62	13.09	10.28	9.21	8.00	6.84	5.93	5.27	4.79	4.46	4.23	4.04	3.90	3.86	3.82	3.82	3.87	3.88	3.93	4.03	4.11	4.22	4.36			

[1] Excluding federal taxes, severance tax, stumpage, and interest.

[2] Code for classification of costs:

CA = Constant per acre

V Cap = Varies with the capacity of the cars when they are loaded with logs of one size only

VT = Varies with the time per thousand board feet required for lumber from logs of different sizes

VMT = Varies with the sawing time in the mill per thousand board feet for logs of different sizes

Where only one log is handled at a time as in skidding and loading it takes about as much time to load or skid a small log as a medium-sized one, hence the extra high cost per M. In addition, tongs do not grip small logs well and time is lost in "back-ups" for rehooking when the tongs pull loose. For loading, a similar situation arises, for the hooks do not set securely on small logs and time is lost when they pull out and the log drops to the ground and has to be hooked again. For the largest logs the output in number of logs per unit of time for skidding and loading is slowed down somewhat as compared to small logs, but the volume handled is so much greater that the cost per M is lower.

OVERRUN FOR LONGLEAF PINE TREES AND LOGS

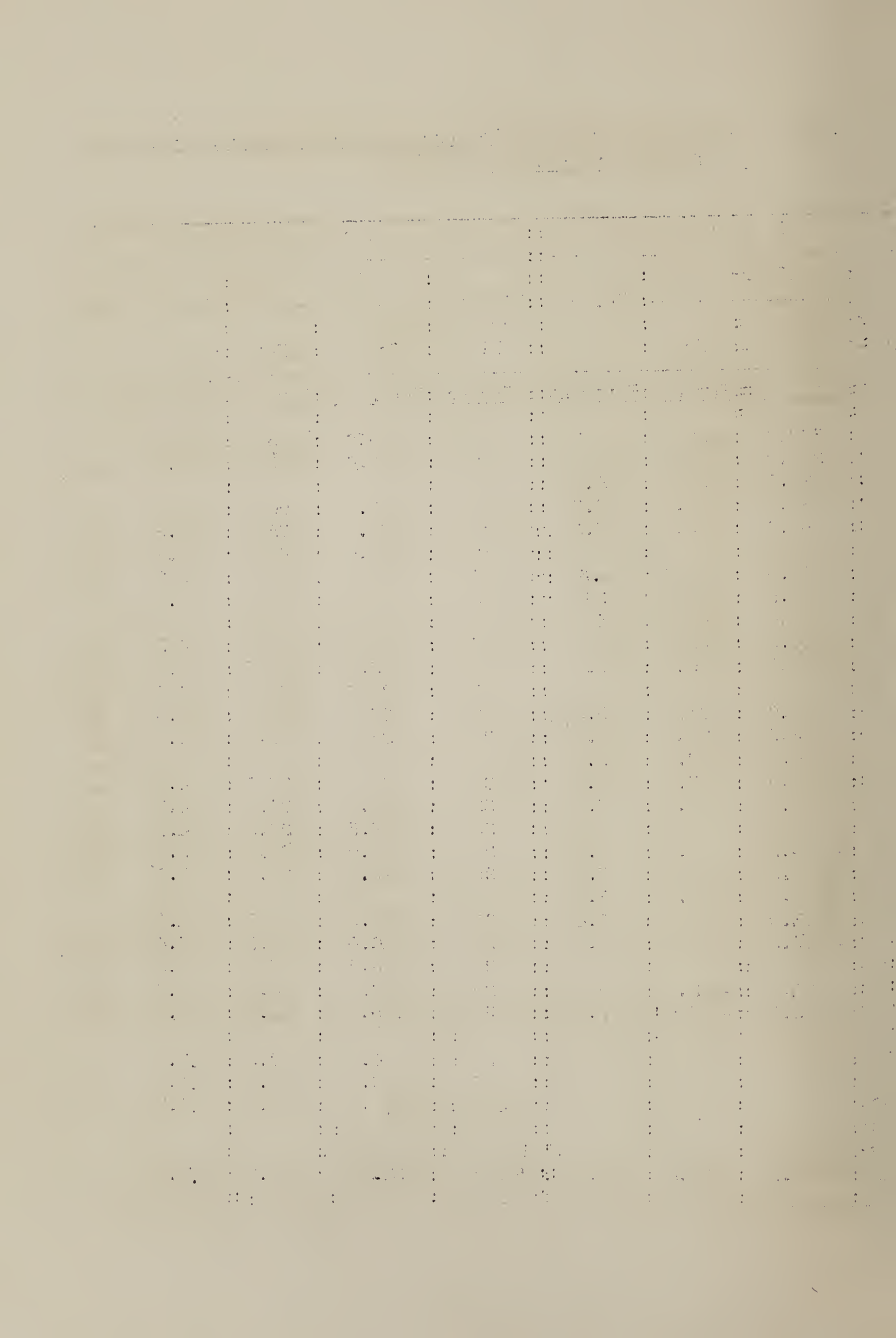
The logs were scaled with a Doyle rule using the lengths into which they were finally sawed after the crosscutting at the mill. Determining the volume of the logs in log scale was necessary because the logging costs were kept on this basis, but so far as this study is concerned it was only a means to an end, for board measure for the lumber and cubic feet for the timbers were the units upon which final costs and returns were computed. In order to be able to convert the woods costs to a lumber tally basis it was necessary to determine the difference between the volume of the logs in log scale and in lumber tally. ~~Gross~~ Net overrun is the amount by which the lumber tally exceeds the net log scale (gross scale less deductions for defects). In the event the lumber tally is less than the log scale the difference is called underrun.

Table 4 gives the figures for overrun for logs and trees and the percentage of defect. The average gross overrun was 21.9 per cent, which means that on the average for each 1,000 feet log scale 1,219 feet of lumber and timbers were obtained. Overrun percentages were applied in converting log scale costs to a lumber tally basis as follows: Table 2 gives the average cost of logging as $5.63 per M board feet log scale, which reduced to a lumber tally basis $\left(\frac{5.63}{121.9} \times 100\right)$ becomes $4.62 per M board feet lumber tally. Similar computations were made for all items of logging and the results hereafter are shown on a lumber tally basis.

The percentage of defect shown in Table 4 is for the logs that were brought to the mill. The total defect, however, which includes defective material left in the woods, amounts to 15.4 per cent. Defect will be discussed in detail later in the report.

Table 4.--Gross and net overrun and the percentage defect for virgin longleaf pine logs and trees

Logs				Trees			
Top diameter inside bark	Overrun		Defect	Diameter breast high	Overrun		Defect
	Gross	Net			Gross	Net	
Inches	Per cent	Per cent	Per cent	Inches	Per cent	Per cent	Per cent
6	320.0	320.0	0	9	165.0	165.0	0
7	213.0	213.0	0	10	112.0	115.0	1.4
8	124.0	125.0	0.4				
9	81.0	86.0	2.7	11	87.0	90.5	1.8
10	60.0	65.5	3.3	12	71.0	75.0	2.3
				13	59.0	63.5	2.8
11	48.5	54.0	3.6	14	50.0	55.0	3.2
12	40.5	46.0	3.8	15	43.0	48.5	3.7
13	34.0	40.0	4.3				
14	28.5	35.0	4.8	16	37.0	43.0	4.2
15	23.5	30.0	5.0	17	32.5	38.5	4.3
				18	29.0	35.0	4.4
16	19.0	25.5	5.2	19	26.0	32.0	4.5
17	14.5	21.0	5.4	20	23.5	29.5	4.6
18	10.5	17.0	5.6				
19	6.5	13.0	5.8	21	21.0	27.0	4.7
20	2.5	9.0	6.0	22	18.5	24.5	4.8
				23	16.5	22.5	4.9
21	-1.5	5.5	6.6	24	15.0	21.5	5.3
22	-5.5	2.0	7.4	25	13.0	20.0	5.8
23	-9.5	-1.5	8.1				
24	-13.0	-5.0	8.4	26	11.5	18.5	5.9
25	-16.5	-8.5	8.8	27	10.0	17.5	6.4
				28	8.5	16.0	6.5
26	-20.0	-12.0	9.1	29	7.0	14.5	6.6
27	-24.0	-16.0	9.6	30	5.5	13.5	7.0
				31	4.0	12.5	7.6
				32	2.5	11.0	7.7
				33	1.0	10.0	8.2
Weighted average	21.9	28.2	4.9	Weighted average	21.9	28.2	4.9



TOTAL PRODUCTION COST FOR LONGLEAF PINE LOGS AND TREES OF DIFFERENT DIAMETERS

Total production cost includes all costs except stumpage, federal taxes, severance tax, and interest. The milling costs were determined directly on a lumber tally basis and the logging costs were converted to a similar unit by means of overrun figures. These costs have been brought together in Tables 5 and 6 to show the total production cost for logs and trees of different diameters. Taking all items together it costs 1.7 times more per M to produce lumber from 10-inch trees than from 24-inch trees. The effect of the high overrun for small trees in reducing the difference in production cost between small and large trees is illustrated in felling. On a lumber tally basis the felling cost for 10-inch trees is only 2.3 times greater than for 24-inch trees, while on a log scale basis (Table 2) the ratio is 4.2 for the same sizes.

For logs, Table 6 shows that 8-inch logs are 1.7 times more costly to handle than 20-inch logs.

The difference in production costs for logs and trees of different diameters is emphasized and recorded definitely here because it has an important bearing on the profits or losses that occur by size classes in handling a stand of timber. The point is sometimes raised that because some woods work is done on a flat rate per M that the size of tree makes no difference. Where a flat rate is paid the small trees bear a smaller felling cost per M and the larger ones a greater cost than would be the case if the costs are prorated on the basis of the actual labor involved in cutting them. Flat rates, too, are based on timber of a given average size. If saw crews are put to work cutting smaller timber at the same flat rate, earnings immediately drop and an adjustment in the rate usually takes place. Furthermore, overhead increases as the log cutter's output decreases, so that the effect of tree sizes must be given consideration even though a flat rate is paid. Those who wish to follow the flat rate policy can adjust the production costs easily from the data given in this report.

With production costs available it is necessary to evaluate the lumber in order to determine the profits or losses for trees and logs of different sizes.

LUMBER PRICES

Table 7 gives the lumber prices which were used in the study. Table 8 gives the sales value based on Table 7 figures of a thousand feet of green lumber after allowing for the loss due to

Table 5.--Production costs[1] per thousand board feet, lumber tally, for virgin longleaf pine trees

Cost item	Classification of costs[2]	Weighted average cost per M bd. ft. lumber tally	Itemized costs for the indicated diameter breast high in inches																										
			9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Felling - labor, supplies, miscellaneous costs	VT	0.67	1.62	1.35	1.18	1.08	1.01	0.93	0.86	0.80	0.74	0.71	0.66	0.63	0.61	0.59	0.59	0.59	0.60	0.61	0.62	0.64	0.65	0.68	0.70	0.73	0.77
Skidding - labor, cables, fuel, supplies, repairs	VT	1.05	5.71	5.22	3.75	2.87	2.55	2.29	1.99	1.69	1.43	1.26	1.09	0.98	0.87	0.80	0.72	0.69	0.65	0.62	0.57	0.53	0.50	0.45	0.40	0.36	0.34
Loading - labor, cables, fuel, supplies, repairs	VT	0.26	1.24	1.08	0.87	0.70	0.58	0.51	0.46	0.41	0.36	0.32	0.29	0.25	0.22	0.20	0.19	0.17	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.14
Spurs - labor, ties, supplies																													
Reserve for moving railroad and camp	CA	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Railroad maintenance, miscellaneous camp expense	VMT	0.36	0.49	0.49	0.48	0.48	0.48	0.47	0.46	0.45	0.44	0.42	0.39	0.37	0.35	0.34	0.33	0.32	0.31	0.30	0.29	0.28	0.27	0.26	0.25	0.24	0.23
Railroad transportation, train labor, fuel, supplies, repairs, wheelage	V Cap	0.99	1.46	1.43	1.37	1.32	1.26	1.21	1.17	1.12	1.08	1.04	1.01	0.98	0.96	0.95	0.94	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.93
Unloading and pond labor, material, supplies		0.20																											
Sawmill - labor, supplies, repair	VMT	1.53	2.13	2.96	2.94	2.92	2.91	2.89	2.85	2.81	2.74	2.64	2.53	2.38	2.23	2.12	2.04	1.99	1.95	1.89	1.84	1.78	1.71	1.65	1.57	1.50	1.42	1.37
Timber sizer and dock:-labor, supplies and repairs; Green yard sorter		0.19 0.26																											
Transferring and stacking yard lumber, Labor, supplies, repairs	No.pcs. and qty.	0.17	0.32	0.25	0.24	0.21	0.24	0.18	0.17	0.19	0.18	0.17	0.16	0.16	0.17	0.19	0.17	0.14	0.14	0.17	0.16	0.14	0.13	0.13	0.11	0.21	0.07
Yard planer, edge sorter and stacker, dry lumber sorter, labor, supplies and repairs	VMT	0.50	0.68	0.67	0.67	0.67	0.66	0.65	0.64	0.63	0.61	0.58	0.55	0.51	0.49	0.47	0.46	0.45	0.43	0.42	0.41	0.39	0.38	0.36	0.34	0.33	0.31
Dry kilns and cooling shed: dry rough shed	No.pcs. and qty	0.33	0.64	0.41	0.34	0.41	0.39	0.39	0.38	0.39	0.37	0.35	0.34	0.37	0.31	0.31	0.33	0.27	0.32	0.31	0.28	0.32	0.29	0.33	0.29	0.24	0.48
Dry planer	C	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Dressed shed	No.pcs. and qty	0.11	0.21	0.14	0.11	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.10	0.10	0.11	0.09	0.10	0.10	0.09	0.10	0.09	0.10	0.09	0.08	0.14
Power		0.47																											
Plant, general expense		0.28																											
Mill terminal	VMT	0.05	0.81	1.10	1.09	1.09	1.08	1.07	1.06	1.04	1.02	0.98	0.94	0.88	0.83	0.79	0.76	0.74	0.72	0.70	0.68	0.66	0.63	0.61	0.59	0.56	0.53	0.50
Lumber trucks		0.01																											
Selling	O	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Loading and shipping: Labor and supplies	No.pcs.	0.57	1.05	1.01	0.96	0.90	0.85	0.80	0.75	0.71	0.67	0.63	0.60	0.57	0.55	0.52	0.50	0.49	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Demurrage, switching	VMT	0.10	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.06		
Contributions		0.07																											
Insurance on plant		0.38																											
Insurance on compensation		0.22																											
Insurance on liability	VMT	0.07	4.14	5.62	5.59	5.55	5.52	5.48	5.41	5.34	5.20	5.02	4.81	4.52	4.24	4.02	3.88	3.77	3.70	3.60	3.49	3.38	3.24	3.13	2.99	2.85	2.71	2.56	
Depreciation		1.71																											
Tax on plant		1.69																											
Association dues	C	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Commercial discount		0.31																											
Tax on lumber	VP	0.05	0.41	0.28	0.30	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.42	0.43	0.44	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.51	
Insurance on lumber		0.05																											
Total		16.52	27.39	25.97	23.84	22.60	21.92	21.22	20.54	19.83	19.00	18.25	17.35	16.60	15.94	15.53	15.23	14.90	14.71	14.50	14.21	13.96	13.69	13.44	13.08	12.86	12.76		

[1] Excluding federal taxes, severance tax, stumpage, and interest.

[2] Code for classification of costs:

C = Constant per thousand board feet
CA = Constant per acre
V Cap = Varies with the capacity of the car when loaded with logs of one size only
VMT = Varies with the sawing time in the mill per thousand board feet for trees of different sizes
VP = Varies with the price
VT = Varies with the time per thousand board feet for trees of different sizes
No.pcs. and qty. = Varies with the number of pieces needed to make up a thousand board feet and the proportion of the cut handled
No.pcs. = Varies with the number of pieces needed to make up a thousand board feet

M200035

Table 6.--Production costs[1] per thousand board feet, lumber tally, for virgin longleaf pine logs

Cost item	Classification of costs[2]	Weighted average cost per M bd. ft. lumber tally	Itemized costs for the indicated diameter inside the bark at the small end in inches																						
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
		Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Felling - labor, supplies, miscellaneous costs	VT	0.67	1.35	1.12	1.08	1.02	0.94	0.85	0.75	0.68	0.63	0.60	0.58	0.57	0.57	0.56	0.59	0.63	0.68	0.72	0.78	0.86	0.94	1.04
Skidding - labor, cables, fuel, supplies, repairs	VT	1.05	6.40	4.92	4.21	3.32	2.51	1.88	1.47	1.18	0.98	0.85	0.76	0.65	0.62	0.59	0.57	0.54	0.50	0.46	0.46	0.44	0.42	0.42
Loading - labor, cables, fuel, supplies, repairs	VT	0.26	1.51	1.06	0.85	0.67	0.53	0.44	0.36	0.31	0.26	0.23	0.19	0.17	0.16	0.16	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.17
Spurs - labor, ties, supplies. Reserve for moving railroad and camp	CA	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Railroad maintenance, miscellaneous camp expense	VMT	0.36	0.69	0.56	0.51	0.48	0.45	0.43	0.41	0.39	0.37	0.35	0.33	0.32	0.31	0.30	0.30	0.31	0.31	0.32	0.33	0.34	0.35	0.36
Railroad transportation,- train labor, fuel, supplies, repairs, wheelage	V Cap	0.99	1.86	1.33	1.28	1.23	1.14	1.05	0.99	0.96	0.93	0.92	0.91	0.91	0.91	0.92	0.94	0.95	0.97	0.99	1.01	1.03	1.06	1.09
Unloading and pond labor, material, supplies		0.20																						
Sawmill - labor, supplies, repairs	VMT	1.53	2.18	4.18	3.39	3.07	2.89	2.72	2.59	2.46	2.34	2.23	2.12	2.02	1.91	1.86	1.84	1.84	1.86	1.87	1.91	1.97	2.04	2.10	2.16
Timber sizer and dook:-labor, supplies and repairs		0.19																						
Green yard sorter		0.26																						
Transferring and stacking yard lumber. Labor, supplies and repairs	No.pcs. and qty.	0.17	0.39	0.28	0.26	0.29	0.23	0.27	0.22	0.21	0.19	0.15	0.15	0.13	0.15	0.13	0.11	0.13	0.14	0.15	0.11	0.09	0.07	0.04
Yard planer, edge sorter and stacker, dry lumber sorter	VMT	0.50	0.96	0.78	0.71	0.66	0.62	0.59	0.56	0.54	0.51	0.49	0.46	0.44	0.43	0.42	0.42	0.43	0.43	0.44	0.45	0.47	0.48	0.49
Dry kilns and cooling shed: dry rough shed	No.pcs. and qty	0.33	0.67	0.38	0.35	0.35	0.36	0.30	0.30	0.30	0.31	0.30	0.31	0.34	0.31	0.30	0.34	0.44	0.38	0.38	0.52	0.57	0.59	0.62
Dry planer	C	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Dressed shed	No.pcs. and qty	0.11	0.22	0.13	0.12	0.12	0.12	0.13	0.10	0.10	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.14	0.12	0.12	0.16	0.17	0.18	0.18
Power		0.47																						
Plant, general expense	VMT	0.28	0.81	1.55	1.26	1.14	1.07	1.01	0.96	0.91	0.87	0.83	0.79	0.75	0.71	0.69	0.68	0.68	0.69	0.70	0.71	0.73	0.76	0.78	0.80
Mill terminal		0.05																						
Lumber trucks		0.01																						
Selling	C	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Loading and shipping: Labor and supplies	No.pcs.	0.57	1.07	1.02	0.96	0.86	0.74	0.67	0.63	0.59	0.55	0.53	0.51	0.50	0.50	0.51	0.51	0.52	0.52	0.53	0.53	0.53	0.53	0.54
Demurrage, switching, and other costs	VMT	0.10	0.19	0.16	0.14	0.13	0.12	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.09	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.10	0.10
Contributions		0.07																						
Insurance on plant		0.38																						
Insurance on compensation		0.22																						
Insurance on liability	VMT	0.07	4.14	7.94	6.44	5.84	5.48	5.16	4.91	4.66	4.45	4.24	4.02	3.84	3.63	3.52	3.49	3.49	3.52	3.56	3.63	3.74	3.88	3.99	4.09
Depreciation		1.71																						
Taxes on plant		1.69																						
Association dues	C	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Commercial discount		0.31																						
Tax on lumber	VP	0.05	0.41	0.28	0.29	0.29	0.30	0.31	0.32	0.33	0.35	0.37	0.40	0.42	0.44	0.47	0.49	0.50	0.51	0.52	0.52	0.52	0.52	0.52
Insurance on lumber		0.05																						
Total		16.52	33.13	26.99	24.68	22.74	20.83	19.38	18.13	17.25	16.47	15.82	15.29	14.79	14.56	14.44	14.49	14.78	14.81	14.99	15.43	15.82	16.14	16.49

[1] Excluding federal taxes, severance tax, stumpage, and interest.

[2] Code for classification of costs:

C = Constant per thousand board feet
CA = Constant per acre
V Cap = Varies with the capacity of the car when loaded with logs of one size only
VMT = Varies with the sawing time in the mill per thousand board feet for logs of different sizes
VP = Varies with the price
VT = Varies with the time per thousand board feet for logs of different sizes
No.pcs. = Varies with the number of pieces needed to make up a thousand board feet
No.pcs. and qty. = Varies with the number of pieces needed to make up a thousand board feet and the proportion of the cut handled

M200045

Table 7.--Average prices of lumber per thousand board measure for virgin longleaf pine lumber f.o.b. mill 1930

Lumber grade	Thickness	Widths - inches				
		4	6	8	10	12
	Inches					
Prime	4/4	$62.00				
"	5/4, 6/4 & 8/4	72.00				
"	10/4	78.00				
B and Better	4/4	40.00	$40.00	$40.00	$46.00	$60.00
" " "	5/4, 6/4 & 8/4	50.00	50.00	50.00	58.00	65.00
85 per cent heart	4/4	40.00	40.00	40.00	48.00	58.00
" " " "	5/4 and 6/4	49.00	49.00	49.00	52.00	62.00
No. 1 Common	4/4	32.00	32.00	32.00	40.00	50.00
" " "	5/4 and 6/4	41.00	41.00	41.00	44.00	54.00
No. 2 Common	4/4	15.00	17.00	18.00	20.00	30.00
" " "	5/4	24.00	24.00	24.00	26.00	28.00
No. 3 Common	All	10.00	11.00	12.00	12.00	14.00
No. 1 Dimension	8/4	22.64	21.22	22.09	29.16	38.75
No. 2 Dimension	8/4	20.13	18.41	19.07	21.24	23.68
No. 3 Dimension	8/4	13.00	12.00	12.00	13.00	14.00
Ceiling: B & Better		26.00				
No. 1		24.00				
No. 2		16.00				
Edge grain: B & Better		80.00				
No. 1		60.00				
No. 4 Common	All	6.00				

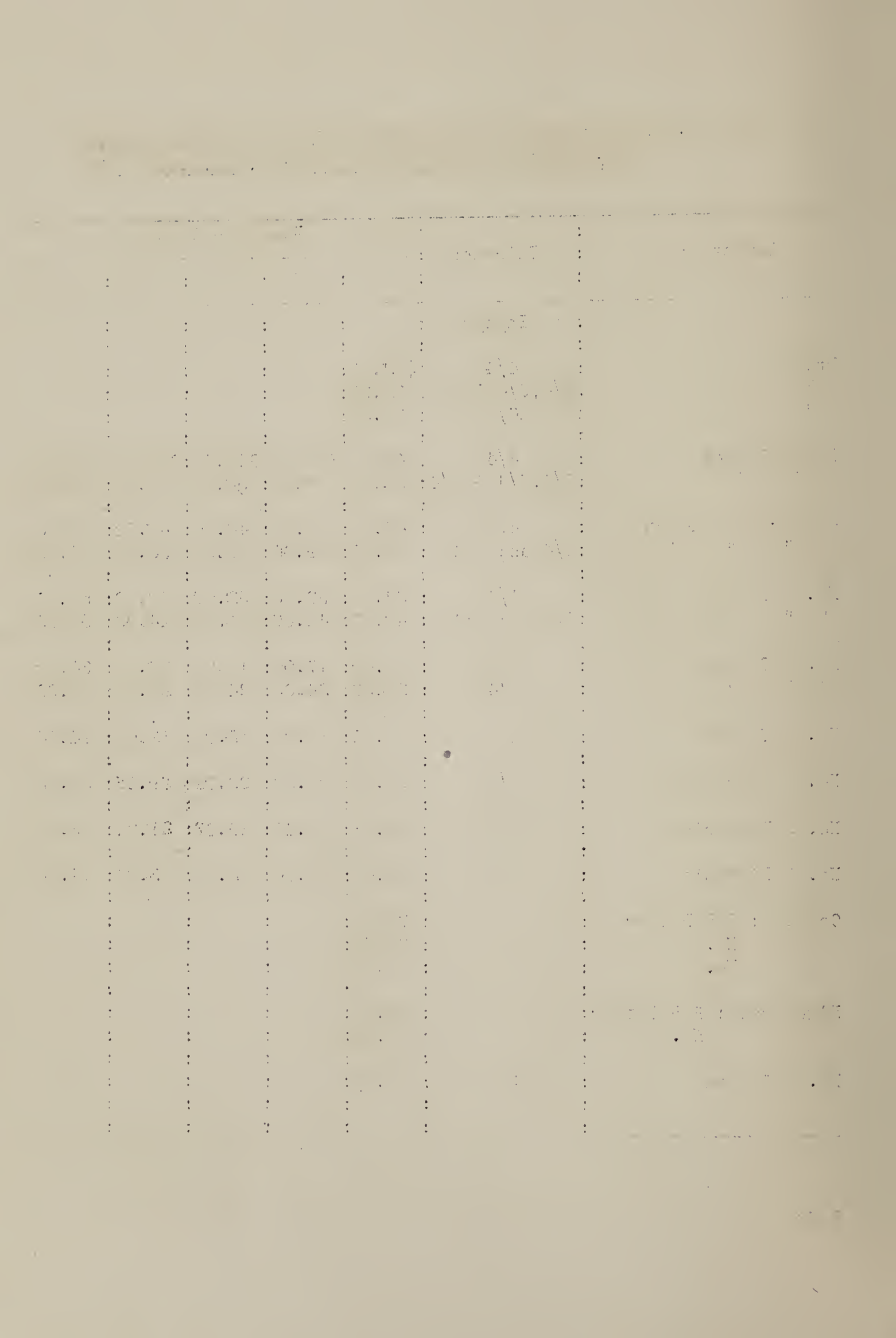


Table 8.--Average prices per thousand feet board measure for green virgin longleaf pine lumber f.o.b. mill, 1930[1]

Lumber grade	Thickness	Widths - inches				
		4	6	8	10	12
	Inches					
Prime	4/4	$60.08				
"	5/4 to 6/4 and 8/4	64.22				
"	to 10/4	69.58				
B and Better	4/4	37.64	$37.64	$37.64	$43.29	$56.46
" " "	5/4,6/4,8/4 and 10/4	44.60	44.60	44.60	51.74	57.98
85 per cent heart	4/4	38.28	38.28	38.28	45.94	55.51
" " " "	5/4 and 6/4	46.89	46.89	46.89	49.76	59.33
No. 1 Common	4/4	29.66	29.66	29.66	37.08	46.35
" " "	5/4 and 6/4	39.24	39.24	39.24	42.11	51.68
No. 2 Common	4/4	13.32	15.10	15.98	17.76	26.64
" " "	5/4	22.22			24.08	25.93
No. 3 Common	All	10.00	11.00	12.00	12.00	14.00
No. 1 Dimension	8/4	21.37	20.03	20.85	27.53	36.58
No. 2 Dimension	8/4	19.73	18.23	18.88	21.24	23.68
No. 3 Dimension	8/4	13.00	12.00	12.00	13.00	14.00
Ceiling: B		26.00				
No. 1		24.00				
No. 2		16.00				
Edge grain: B		80.00				
No. 1		60.00				
No. 4 Common	All	6.00				
Moulding		$1.25 per 100 lineal feet				

[1]Prices after allowing for drying and planing mill loss.

R972

Table 9.--Average prices per thousand feet board measure for virgin longleaf timbers, f.o.b. mill, 1930

Grade of timber	Cross-section	Length - in feet					
		10 to 20	22 to 24	26	28	30	32
	Inches						
Square edged and sound	2-1/4 x9) 4x9)	$30.50	$32.50	$33.50			
	6x6	24.00	26.00	28.00			
	2-1/4 x10) 3x10)	35.00	37.00	38.00			
	4x12	48.00	50.00	51.00			
	6x14	53.00	55.00	56.00			
No. 1 Common	4x8) 6x6) 6x8)	24.00	26.00	28.00	$29.00	$30.00	
	6x9	27.50	29.50	30.50	31.50	32.50	
	3x12	47.00	49.00	50.00	52.00	54.00	
	10x10	31.00	33.00	34.00	35.00	36.00	
	12x12	43.00	45.00	46.00	47.00	48.00	
	12x13	47.50	49.50	50.50	51.50	52.00	
	12x14	52.00	54.00	55.00	57.00	59.00	
No. 1 Common 85 per cent heart	4x8) 6x6) 6x8) 8x8)	32.00	34.00	36.00	37.00	38.00	$39.00
	3x6	33.00	35.00	37.00	38.00	40.00	42.00
	8x10	39.00	41.00	42.00	43.00	44.00	45.00
	8x12) 10x12)	51.00	53.00	54.00	55.00	56.00	58.00
Rio Deals	3x9) 4x9)	43.00	43.00	43.00			

Merchantable Sawn Timbers

6"x6" to 10"x10" average	8x8" - 26' to 27'	linear average	$21.00
25 cubic feet average	27' to 28'	" "	37.00
30 " " "	28' to 30'	" "	41.50
35 " " "	29' to 31'	" "	44.50
40 " " "	30' to 32'	" "	48.50
12" x 12"	26' to 27'	" "	45.50
6" x 12"	26' to 27'	" "	41.50

kiln drying and remanufacture. Table 9 gives the prices for the timbers that were cut during the study. All prices represent an average for 1930 at the mill.

GRADES AND VALUE OF LUMBER

The quality of the lumber and timbers that trees of different sizes, form, and soundness produce varies considerably and an accurate determination of the value of a tree can be obtained only by cutting it and grading the products which it yields. Tables 10 and 11 show the percentages of the different grades of lumber and timbers and the value per M for trees and logs of different sizes. These grade percentages are based on a green lumber tally but the lumber values have been adjusted to take into account drying and planing mill losses. No degrade or loss was considered for the timbers.

Longleaf pine is an excellent species for timbers, and for this reason the amount of B and Better does not exercise so great an influence on the value of the tree as it does in shortleaf and loblolly pine, where timbers are of much less importance. In this study an average of 37 per cent of the total output was sawed into timbers. The proportion of timbers cut by diameter classes varied from 7.7 per cent for the 33-inch diameter class to 64.7 per cent for the 11-inch class. In general a larger proportion of the small and medium-sized trees were sawed into timbers than of the larger trees. The proportion of B and Better lumber increased from 6 to 8 per cent for small trees to 26 to 33 per cent for the largest trees. The value of the B and Better lumber increased from $38.32 for 10-inch trees to $51.42 for 30-inch trees largely because of wider widths and the recovery of some edge grain flooring stock. Similarly, the timbers sawed from larger trees were worth more per M than that from small trees largely because they were of larger cross-sectional area and in some instances their average length was greater. The average value per M board feet of the lumber and timbers together for 10-inch trees was $23.60 as compared with $38.15 for 30-inch trees. The spread in value for these two diameters is less than would have been the case had both been cut into lumber because the timbers cut from the small trees brought a price slightly better than for No. 1 Common lumber, whereas they would have cut out very little lumber of this grade had they been cut into boards.

The quality and price trends and percentage of timber by sizes as shown for longleaf pine trees apply generally for logs. The lumber and timbers from 10-inch logs, for example, were worth only $23.70 per M, whereas that from 24-inch logs had a value of $40.50. The percentage of B and Better lumber increased generally with the size of the log.

Table 10.--Peroentage bf the total mill output and sales value per thousand board feet, lumber tally, of the various grades sawed from virgin longleaf pine trees of different diameters in a typical woods-run cut in southern Louisiana

Diameter breast high	Grade in green condition																		Average value per M bd. ft. of green lumber when dry and dressed	
	Boards										Dimension						Timbers			
	B and Better		85 per oent heart		No. 1 Common		No. 2 Common		No. 3 Common		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension					
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Actual	*Computed*
Inches	Per oent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Dollars	Dollars
9	6.2	41.43			0.9	23.33	13.6	14.13	8.3	10.00	29.1	20.61	3.9	20.00	3.3	12.73	34.7	29.23	22.87	22.90
10	8.1	38.32	1.6	28.18	3.8	29.62	12.8	13.43	4.6	11.09	7.5	21.33	1.3	20.00	0.6	12.50	59.7	26.60	24.72	23.60
11	9.9	37.99			3.8	29.62	13.2	13.83	4.0	9.55	2.1	20.69	1.0	18.93	1.3	13.14	64.7	25.49	24.38	24.30
12	10.5	38.91	0.8	31.38	3.7	30.45	19.8	14.07	2.7	10.31	2.9	20.97	2.3	19.02	1.0	12.43	56.3	26.23	24.46	25.05
13	12.6	39.43	2.0	27.62	4.3	29.61	14.7	14.09	7.1	9.73	3.8	20.44	2.5	18.30	1.4	12.24	51.6	26.99	24.89	25.75
14	13.3	40.77	3.0	31.40	3.2	30.41	15.9	14.38	3.7	10.25	5.3	20.51	2.6	18.80	0.6	12.14	52.4	28.19	26.42	26.45
15	15.1	39.70	1.6	29.27	3.5	29.57	16.2	14.50	3.5	10.39	4.9	20.34	2.1	19.09	0.7	12.09	52.4	28.82	26.79	27.20
16	20.2	40.25	3.7	32.28	3.2	30.22	11.7	14.64	5.6	10.94	6.1	20.70	3.6	18.70	1.8	11.99	44.1	31.03	28.45	27.95
17	16.9	40.12	2.6	33.84	6.1	31.59	12.6	15.37	5.5	10.07	7.9	20.60	3.9	19.11	2.6	12.21	41.9	29.46	27.11	28.65
18	21.8	41.75	3.0	32.73	3.1	31.29	11.9	15.30	3.9	10.34	5.7	20.78	5.8	19.20	1.8	12.11	43.0	30.14	28.75	29.40
19	21.0	41.00	4.5	33.63	4.1	31.96	10.3	15.50	4.9	11.30	6.4	21.12	4.4	18.84	1.2	12.23	43.2	30.58	29.12	30.10
20	22.1	43.52	7.8	36.31	4.2	32.75	10.2	15.86	6.5	10.63	8.1	22.00	6.5	19.53	1.0	12.53	33.6	32.68	30.29	30.85
21	20.7	43.15	5.3	40.47	4.3	33.15	9.2	16.42	6.2	11.00	7.0	22.33	6.8	20.01	2.3	12.82	38.2	33.93	30.87	31.55
22	20.2	45.28	5.3	37.75	4.1	32.83	10.8	17.89	10.0	11.49	8.1	26.06	7.5	20.88	2.6	13.26	31.4	37.90	31.50	32.30
23	22.9	46.43	11.1	40.52	5.0	36.38	9.8	17.41	8.1	11.29	5.4	23.81	8.4	20.93	2.2	13.00	27.1	40.33	33.83	33.00
24	23.2	47.06	6.5	42.81	2.9	33.56	8.6	17.44	6.0	11.94	4.9	24.48	6.5	20.65	1.3	13.35	40.1	43.51	37.05	33.75
25	22.5	49.04	7.4	42.24	6.1	37.43	11.4	18.32	5.7	10.81	7.3	26.98	7.0	21.52	2.0	13.30	30.6	41.58	35.61	34.50
26	18.1	46.79	8.9	45.63	5.6	37.24	13.2	20.02	12.5	12.75	6.8	27.88	7.0	21.11	1.7	13.68	26.2	45.57	34.40	35.20
27	21.6	48.89	6.4	43.86	5.4	36.06	9.9	19.24	11.0	11.93	5.0	26.99	5.6	21.32	2.1	13.12	33.0	42.83	35.48	35.95
28	26.1	49.23	6.5	42.95	3.5	35.54	12.7	19.40	8.3	11.94	6.8	28.90	5.7	22.22	1.6	13.03	28.8	42.67	36.07	36.70
29	27.0	49.56	5.1	39.78	3.1	35.80	11.6	19.83	5.3	12.05	3.2	24.66	6.1	21.71	0.9	13.55	37.7	43.06	37.93	37.45
30	16.0	51.42	7.0	49.50	5.0	35.92	16.2	21.97	4.9	10.86	12.1	30.58	9.5	22.29	0		29.3	44.50	36.44	38.15
31	15.5	45.27	10.8	46.27	9.1	40.39	2.8	18.00	1.6	10.25	11.1	30.64	6.2	23.27	0.5	12.31	42.4	48.50	41.83	38.90
32	32.7	51.76			2.1	35.93	2.0	16.80	25.3	12.00	4.2	32.83					33.7	48.45	38.76	39.45
33	33.1	55.87	27.1	45.66	5.0	31.30	13.5	19.86	6.2	7.79	3.6	26.15			3.8	12.14	7.7	41.55	40.20	39.80
Weighted average	20.6	44.75	5.9	39.69	4.3	33.90	11.1	16.81	6.8	11.30	6.5	23.86	6.0	20.44	1.7	12.86	37.1	35.41	31.79	31.80

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Table 11.--Percentage of the total mill output and sales value per thousand board feet, lumber tally, of the various grades sawed from virgin longleaf pine logs of different diameters in a typical woods-run cut in southsrn Louisiana

Diametsr inside bark	Grads in green oondition																		Avsrage value per M bd. ft. of grsen lumber when dry and dressed	
	Boards										Dimension						Timbers			
	B and Bettsr		85 per oent heart		No. 1 Common		No. 2 Common		No. 3 Common		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension					
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Valus	Amount	Value	Actual	*Computed*
Inches	Per oent	Dollars	Per cent	Dollars	Per cent	Dollars	Psr cent	Dollars	Per cent	Dollars	Per osnt	Dollars	Per cent	Dollars	Per cent	Dollars	Psr cent	Dollars	Dollars	Dollars
6	2.0	36.67					11.2	13.53	3.9	10.00	38.2	21.38	11.8	20.00	5.3	12.50	27.6	26.19	21.06	21.95
7	3.0	38.06	0.3	28.75	1.0	28.80	18.8	13.46	5.2	10.08	7.7	20.35	2.6	19.37	0.8	12.78	60.6	26.74	22.99	22.30
8	3.2	38.22			1.5	29.60	23.6	13.64	4.1	9.71	1.5	20.53	1.9	18.59	1.7	12.47	62.5	26.72	22.86	22.70
9	5.5	39.23	1.1	28.33	2.1	30.06	19.9	14.35	6.6	9.81	5.0	20.46	5.6	18.56	2.0	12.23	52.2	26.64	22.82	23.10
10	6.0	38.79	2.7	29.70	3.2	29.75	18.0	14.41	5.8	9.86	10.6	20.33	6.5	18.69	1.4	12.13	45.8	28.04	23.63	23.70
11	8.3	40.40	2.0	29.32	2.1	29.76	14.5	14.66	7.2	10.52	9.6	20.36	10.6	18.70	2.3	11.99	43.4	29.72	24.56	24.55
12	10.6	39.15	4.7	30.00	3.2	30.77	13.5	15.01	6.9	10.28	7.4	20.47	8.6	19.06	1.9	12.12	43.2	30.28	25.75	25.75
13	13.6	39.53	3.6	30.59	3.5	31.21	13.4	15.82	6.5	10.61	8.8	20.81	9.5	19.31	1.9	12.20	39.2	31.50	26.62	27.25
14	17.9	40.36	6.1	33.40	3.0	30.11	11.0	15.80	7.8	10.98	8.4	22.41	6.7	20.46	2.9	12.76	36.2	30.75	27.51	28.90
15	21.8	41.68	6.7	39.30	3.6	31.25	8.0	16.58	4.5	11.52	6.3	23.83	6.4	20.83	1.9	13.31	40.8	32.15	30.89	30.65
16	22.2	42.32	9.4	40.59	3.8	32.80	8.2	17.27	7.1	11.44	6.7	24.80	6.6	21.37	1.4	13.20	34.6	35.75	32.31	32.55
17	26.6	43.98	9.7	41.81	4.5	33.87	8.2	18.11	5.4	12.07	6.4	25.75	4.7	21.97	1.8	13.45	32.7	41.35	35.86	34.45
18	25.7	45.60	5.7	43.48	5.9	35.51	9.3	20.35	8.7	11.85	4.1	28.21	4.8	21.40	1.6	13.31	34.2	45.53	37.18	36.40
19	26.6	47.75	3.8	42.54	4.7	36.10	9.0	19.40	6.2	12.26	4.9	31.28	4.2	22.39	1.3	13.42	39.3	45.79	39.16	38.15
20	31.8	49.54	4.5	47.71	4.7	35.90	8.7	20.16	4.5	11.79	4.9	29.86	3.2	22.04	0.8	12.74	36.9	44.35	40.51	38.95
21	33.8	52.34	7.4	45.03	13.7	39.64	13.6	19.16	12.3	12.24	3.0	28.15	1.8	22.23	1.1	13.53	13.3	48.52	38.41	39.55
22	35.3	51.33	5.6	44.72	6.6	37.20	10.1	20.88	9.9	11.99	2.8	29.24	4.3	22.25	0.6	12.77	24.8	46.26	39.70	39.95
23	33.1	53.15	5.4	50.45	8.8	36.88	9.1	18.93	13.3	12.15	3.8	30.14	1.4	20.63	0.9	13.85	24.2	48.49	40.19	40.30
24	40.6	54.18	17.2	48.01	8.5	35.27	12.0	19.54	10.4	8.77	2.5	28.75	2.4	19.62	2.0	12.73	4.4	51.04	40.20	40.50
25																				40.60
26	56.6	59.54	19.6	47.90	2.0	30.00	6.5	25.45	5.9	6.67	5.9	27.67			3.5	12.22			47.80	40.70
27	10.8	43.04	31.1	46.06	42.4	41.83	6.3	22.22	5.6	10.00	3.8	21.25							39.48	40.80
Weightsd average	20.6	44.75	5.9	39.69	4.3	33.90	11.1	16.81	6.8	11.30	6.5	23.86	6.0	20.44	1.7	12.86	37.1	35.41	31.79	31.80

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PRODUCTION COSTS AND LUMBER COMPARED

With production costs (excluding stumpage, federal taxes, severance tax, and interest on invested capital) and values available it is possible to determine the realization for logs and trees of different diameters and for different cutting limits. In making such a comparison it has been assumed that permanent improvement costs are the same per M for small trees as large trees. Table 12 gives the results for trees and shows that at this operation a 11-inch tree paid its way not considering stumpage, etc. The 11-inch class in this case shows an especially high value because about two-thirds the volume was cut into timbers, which brought a price nearly equal to No. 1 Common lumber, whereas if cut into lumber this size of tree would yield a large percentage of No. 2 and 3 lumber and a small amount of No. 1 Common and Better. This same situation prevails in all the smaller diameters, but the proportion of timbers that were cut was somewhat smaller for other sizes of trees. If a stumpage charge of $4.50 is made and a $2.00 margin for profit is required then on the average 15-inch trees would be the smallest that could be cut.

On the average the spread between production cost and lumber and timber value was $15.28 per M board feet for the entire stand, but it ranged from a loss of $4.49 for 9-inch trees to a positive margin of $24.71 for 30-inch trees.

Table 13 gives costs and returns for logs of different sizes and shows that on the average 9-inch logs just pay their way if no charge is made for stumpage, interest, federal taxes, and severance tax. If $4.50 stumpage and $2.00 per M for profit are necessary, then on the average the minimum size of log that could be handled would be about 11 or 12 inches. Marginal logs, however, need not be charged with all expenses, for certain improvements, such as railroads. camps, and the like, had to be installed in order to take out the better logs, and lumber companies often compute their costs accordingly. Marginal logs once they are on the ground are of no value unless utilized, whereas small logs in thrifty standing trees are valuable as growing stock and yield the best return if left to grow. For the small, top log or for the defective log, however, it is often possible to at least get some return and perhaps obtain a small margin if costs are computed, so that such logs need not bear felling, railroad, camp, and in some cases mill depreciation charges. This is a mooted question but from a utilization as well as operating standpoint the above approach has merit.

The production costs were fairly low at the operation studied which made it possible to use smaller trees and logs than would be possible at operations where higher costs obtain. This point should be kept in mind in considering the minimum cutting limits determined here.

Table 12.--Difference between production cost[1] and value of lumber for virgin longleaf pine trees of different diameters

Diameter breast high	Total lumber production cost	Value of lumber	Difference	
			Loss	Gain
	Per M feet lumber tally			
Inches				
9	$27.39	$22.90	$ 4.49	
10	25.97	23.60	2.37	
11	23.84	24.30		$ .46
12	22.60	25.05		2.45
13	21.92	25.75		3.83
14	21.22	26.45		5.23
15	20.54	27.20		6.66
16	19.83	27.95		8.12
17	19.00	28.65		9.65
18	18.25	29.40		11.15
19	17.35	30.10		12.75
20	16.60	30.85		14.25
21	15.94	31.55		15.61
22	15.53	32.30		16.77
23	15.23	33.00		17.77
24	14.90	33.75		18.85
25	14.71	34.50		19.79
26	14.50	35.20		20.70
27	14.21	35.95		21.74
28	13.96	36.70		22.74
29	13.69	37.45		23.76
30	13.44	38.15		24.71
31	13.08	38.90		25.82
32	12.86	39.45		26.59
33	12.76	39.80		27.04
Weighted average	16.52	31.80		15.28

[1] Excluding federal taxes, severance tax, stumpage, and interest.

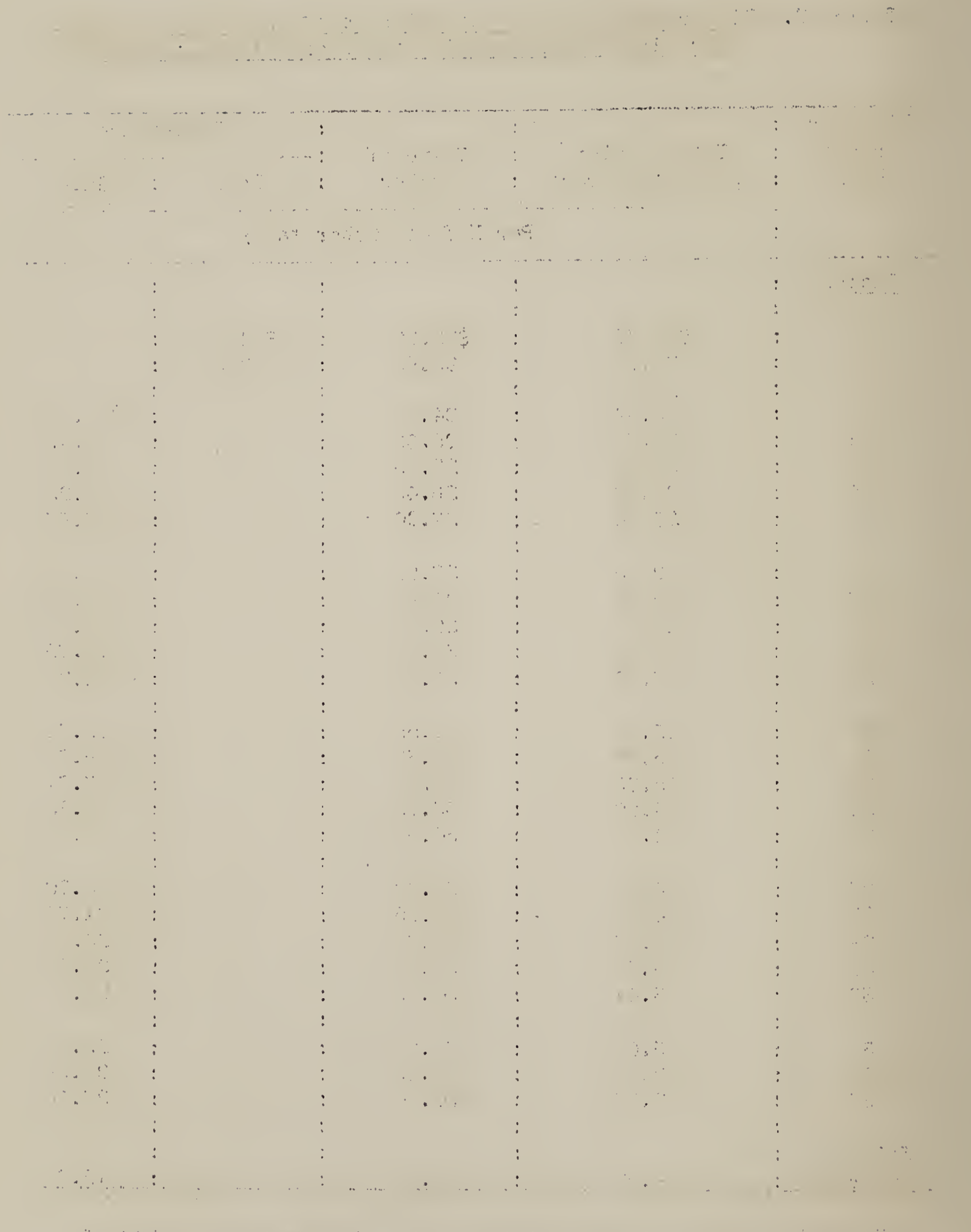

Table 13.--Difference between production cost[1] and value of lumber for virgin longleaf pine logs of different diameters

Top diameter inside bark	Total lumber production cost	Value of lumber	Difference	
			Loss	Gain
	Per M feet lumber tally			
Inches				
6	$33.13	$21.95	$11.18	
7	26.99	22.30	4.69	
8	24.68	22.70	1.98	
9	22.74	23.10		$ .36
10	20.83	23.70		2.87
11	19.38	24.55		5.17
12	18.13	25.75		7.62
13	17.25	27.25		10.00
14	16.47	28.90		12.43
15	15.82	30.65		14.83
16	15.29	32.55		17.26
17	14.79	34.45		19.66
18	14.56	36.40		21.84
19	14.44	38.15		23.71
20	14.49	38.95		24.46
21	14.78	39.55		24.77
22	14.81	39.95		25.14
23	14.99	40.30		25.31
24	15.43	40.50		25.07
25	15.82	40.60		24.78
26	16.14	40.70		24.56
27	16.49	40.80		24.31
Weighted average	16.52	31.80		15.28

[1] Excluding federal taxes, severance tax, stumpage, and interest.

To gain a further idea of the comparative returns to be had from logs of different kinds the logs in this study were separated by diameter classes into three quality groups on the basis of the following log grades:

No. 1 - Surface clear logs from 14 inches to 15 inches and logs 16 inches and over (diameter measured inside the bark) which contain not to exceed three 2 to 4-inch knots. Reasonably straight grained. Length 10 feet and over. Should yield at least 30 per cent B and Better.

No. 2 - Surface clear logs 6 inches to 10 inches (diameter measured inside the bark) and other larger logs containing numerous small knots or more knots than allowed in grade No. 1. Length 8 feet and over. Should yield at least 30 per cent No. 1 Common and Better.

No. 3 - Coarse, knotty crooked logs which do not fall in either of the other two grades. No limitations on size or quality of lumber produced.

Table 14 gives the grades and value for logs of different diameters and grades as found in this study. This table may be of use in buying logs and in determining the relative returns from logs of the same size but of different quality. On the average No. 1 logs were worth $8.14 more per M board feet than the No. 2 logs and the No. 2 logs were worth $6.38 more than the No. 3 logs. Although there is some overlapping of quality and value in logs of the same diameters but from different grades, nevertheless the separation as indicated by value is fairly distinct.

Table 15 gives production costs for each log grade by diameter classes and makes possible a comparison with the lumber values given in Table 14 for the purpose of determining the returns for logs of different sizes and grades. On the average the No. 1 logs show a gross return of $21.77 per M lumber tally, the No. 2 logs $11.16, and the No. 3 logs $2.06. These figures indicate that No. 2 logs must be 9 inches to pay their way and No. 3 logs 10 inches, not including stumpage, etc.

RETURNS FROM DIFFERENT CUTTING LIMITS

The economic side of selective logging is illustrated best by computing the returns for different minimum diameter cutting limits. A rigid diameter limit would not be good practice where a return cut was planned, for under such conditions care must be exercised to see that the trees left are properly distributed and thrifty

Table 14.--Percentage of the total mill output and sales value per thousand board feet, lumber tally, of the various grades sawed from virgin longleaf pine logs of different diameters and log grades in a typical woods-run cut in southern Louisiana

Top diameter inside bark	Grade in green condition: Boards: B and Better: Amount	B and Better: Value	85 per cent heart: Amount	85 per cent heart: Value	No. 1 Common: Amount	No. 1 Common: Value	No. 2 Common: Amount	No. 2 Common: Value	No. 3 Common: Amount	No. 3 Common: Value	Dimension: No. 1 Dimension: Amount	No. 1 Dimension: Value	No. 2 Dimension: Amount	No. 2 Dimension: Value	No. 3 Dimension: Amount	No. 3 Dimension: Value	Timbers: Amount	Timbers: Value	Average value per M bd. ft. of green lumber when dry and dressed: Actual	*Computed*
Inches	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Dollars	Dollars
Log Grade No. 1																				
14	27.2	40.55	5.5	32.54	3.6	30.32	8.1	16.21	3.9	10.77	6.4	21.31	1.9	20.66	1.2	12.45	42.2	28.84	29.72	31.00
15	25.2	41.70	5.9	40.10	3.8	31.17	6.2	17.20	2.6	11.76	5.8	24.22	4.9	20.93	1.9	13.51	43.7	31.46	31.87	32.60
16	26.6	42.53	7.2	41.22	4.3	33.05	6.5	17.72	4.1	11.81	5.7	23.89	4.2	21.14	0.8	13.00	40.6	35.89	34.26	34.40
17	29.1	44.05	8.3	40.48	5.0	34.06	7.3	18.61	4.3	11.99	5.2	26.19	4.1	21.72	1.1	13.38	35.6	41.33	36.87	36.40
18	26.0	45.59	5.0	43.34	6.1	34.60	9.2	20.47	7.9	11.84	3.9	27.64	4.4	21.33	1.5	13.31	36.0	45.62	37.59	38.05
19	28.7	47.85	3.3	43.55	5.1	36.19	8.4	19.58	5.7	12.05	5.1	31.95	3.2	22.42	1.2	13.36	39.3	45.89	39.89	39.35
20	33.6	49.54	3.5	47.99	4.5	36.27	8.5	20.34	3.7	11.91	4.3	29.90	2.9	21.86	0.6	12.48	38.4	44.25	41.11	40.00
21	36.8	52.67	8.3	45.03	12.9	40.38	11.8	19.42	10.2	12.42	2.6	30.63	2.0	22.23	0.5	13.93	14.9	48.52	40.43	40.35
22	36.4	51.33	5.8	44.72	6.5	37.50	10.2	20.95	7.9	11.58	2.9	29.24	4.1	22.13	0.6	12.77	25.6	46.26	40.44	40.50
23	34.3	53.30	5.6	50.45	8.8	36.98	8.5	18.67	11.5	12.08	4.0	30.14	1.4	20.63	0.6	13.75	25.3	48.49	41.18	40.55
24	45.1	54.18	19.0	48.01	8.2	36.15	9.5	18.02	6.6	9.62	2.8	28.75	2.7	19.62	1.2	12.50	4.9	51.04	42.85	40.60
25																				40.60
26	56.6	59.55	19.6	47.90	2.0	30.00	6.5	25.45	5.9	6.67	5.9	27.67					3.5	12.22	47.80	40.70
27	10.8	43.04	31.1	46.06	42.4	41.83	6.3	22.22	5.6	10.00	3.8	21.25							39.48	40.80
Average	29.1	46.04	6.1	42.13	5.3	35.05	8.0	18.91	5.2	11.80	4.9	26.36	3.7	21.44	1.1	13.20	36.6	39.41	36.61	36.60
Log Grade No. 2																				
7	2.7	36.67					21.4	13.75	10.7	10.00	24.1	21.48					41.1	25.65	20.72	23.30
8	13.7	38.81			2.2	30.00	15.3	13.87	3.7	10.00	8.8	20.70	2.7	20.00	2.2	12.73	51.4	28.45	25.73	24.00
9	13.1	39.24			3.7	30.44	12.6	14.70	3.6	8.98	2.3	20.71	1.6	18.68	1.5	12.70	61.6	25.24	24.96	24.80
10	12.6	38.79	4.1	30.96	6.1	29.83	13.8	14.16	3.5	9.70	9.8	20.43	2.1	18.86	1.4	12.04	46.6	26.87	25.36	25.55
11	14.8	40.53	2.0	30.07	3.9	29.75	13.5	14.57	4.6	11.04	7.1	20.52	4.7	18.99	1.0	12.00	48.4	30.28	27.36	26.40
12	16.2	39.25	4.0	29.95	4.4	30.93	12.5	15.18	4.1	10.14	5.8	20.45	4.2	18.79	1.3	11.97	47.5	30.66	27.93	27.25
13	17.7	39.71	4.6	30.79	4.2	31.28	12.3	15.94	4.6	10.81	8.3	20.51	7.2	19.16	1.7	12.17	39.4	32.63	28.36	28.25
14	14.8	40.14	6.6	33.50	3.2	29.91	12.9	15.70	7.4	11.16	8.3	21.48	6.4	20.16	2.2	12.63	38.2	32.67	27.79	29.20
15	16.0	41.66	10.3	38.37	4.0	31.53	10.7	15.81	6.5	11.09	7.3	23.93	5.0	20.39	2.2	12.90	38.0	34.91	30.61	30.20
16	7.7	38.59	28.6	40.79	1.9	29.70	11.3	16.13	6.7	12.26	14.8	27.74	8.3	22.82	3.2	13.55	17.5	34.16	30.26	31.25
17	13.6	43.64	17.0	45.11	1.4	30.49	13.3	16.88	6.5	11.86	13.9	24.54	7.8	22.31	6.2	13.71	20.3	42.31	31.64	32.30
18	35.8	47.97	30.5	44.88	2.9	29.38	6.0	16.06			14.6	33.38	2.2	18.33	2.2	11.67	5.8	25.00	39.66	33.40
19	5.5	41.56	10.7	38.78	0.8	30.00	14.4	18.95	14.3	13.23	4.0	20.73	3.8	22.45			46.5	44.70	33.76	34.25
20	0.4	25.00	39.5	46.94	14.0	32.47	9.0	20.64	3.3	10.59	24.4	29.53	6.9	23.61	2.5	12.31			34.54	35.15
Average	15.1	40.22	7.3	37.07	3.8	30.68	12.5	15.58	5.4	11.05	8.2	22.32	5.6	19.95	1.9	12.65	40.2	31.83	28.47	28.46
Log Grade No. 3																				
6	2.0	36.67					11.2	13.53	3.9	10.00	38.2	21.38	11.8	20.00	5.3	12.50	27.6	26.19	21.06	21.95
7	3.0	38.12	0.3	28.75	1.1	28.80	18.6	13.47	5.0	10.09	6.9	20.81	2.7	19.37	0.8	12.78	61.6	26.78	23.11	22.20
8	2.0	37.78			1.4	29.69	24.5	13.62	4.2	9.68	0.7	20.00	1.8	18.35	1.7	12.30	63.7	26.56	22.51	22.40
9	2.1	39.12	1.7	28.33	1.4	29.61	23.3	14.26	7.2	10.03	6.4	20.41	7.1	18.54	2.0	12.21	48.8	27.44	22.02	22.45
10	1.9	38.80	1.7	27.96	1.5	29.57	20.6	14.51	7.2	9.93	11.1	20.27	9.3	18.65	1.4	12.18	45.3	28.78	22.55	22.40
11	1.3	38.98	2.1	28.55	0.3	29.41	15.5	14.73	9.9	10.26	12.3	20.27	17.1	18.61	3.6	11.99	37.9	28.96	21.58	22.30
12	1.2	36.92	6.0	30.05	1.1	29.73	15.5	14.78	10.1	11.03	10.3	20.49	16.0	19.17	3.0	12.23	36.8	29.46	22.36	22.15
13	3.4	37.23	1.0	28.25	1.7	30.79	16.6	15.61	10.0	10.58	10.2	21.45	15.7	19.28	2.0	12.17	39.4	28.58	22.44	22.00
14	1.4	36.38	6.3	35.07	1.1	29.62	14.0	15.48	18.5	10.97	13.9	24.95	19.5	20.64	8.6	12.97	16.7	32.99	21.36	21.80
15	3.1	42.35	5.2	35.35	1.3	31.43	18.8	15.76	16.0	11.59	8.9	21.12	24.6	20.85	1.0	11.90	21.1	32.52	22.37	21.55
16	1.8	36.67	8.1	34.88	1.7	32.31	19.6	16.81	25.6	10.91	7.9	24.28	25.7	21.18	3.4	13.31	6.2	32.63	19.96	21.40
17	8.9	40.32	18.8	45.95	3.7	32.05	11.9	15.59	26.8	12.48	9.8	25.67	9.0	23.65	6.6	13.00	4.5	32.08	25.56	21.25
18	7.3	39.17	8.9	41.14	1.0	30.00	15.4	18.42	41.4	12.50	3.5	27.65	22.5	22.25					20.81	21.15
19							19.8	16.08					67.7	22.30	12.5	14.06			20.04	21.05
20							11.8	16.96			16.4	30.31	22.6	22.50			49.2	51.04	37.17	21.00
21																				20.90
22					8.5	29.52	6.1	16.67	74.0	13.46			11.4	23.57					16.17	20.85
23	6.3	35.33			7.1	34.12	22.9	21.09	55.4	12.33					8.3	14.00			17.47	20.80
24					11.5	29.60	34.6	23.20	44.7	7.63					9.2	13.00			16.04	20.75
Average	2.2	38.35	3.4	33.75	1.4	30.29	18.3	14.95	11.9	10.87	9.2	21.64	13.7	19.82	3.0	12.55	36.9	28.61	22.08	22.08
Weighted average of all log grades	20.6	44.75	5.9	39.69	4.3	33.90	11.1	16.81	6.8	11.30	6.5	23.86	6.0	20.44	1.7	12.86	37.1	35.41	31.79	31.80

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Table 15.--Difference per M feet lumber tally between production cost[1] and value of lumber for virgin longleaf pine logs of different diameters by log grades

Top diameter inside bark	Log grade No. 1			Log grade No. 2				Log grade No. 3			
	Total lumber production cost	Value of lumber	Difference Gain	Total lumber production cost	Value of lumber	Difference Loss	Difference Gain	Total lumber production cost	Value of lumber	Difference Loss	Difference Gain
Inches											
6								$33.13	$21.95	$1.18	
7				$26.80	$23.30	$3.50		27.05	22.20	4.85	
8				24.50	24.00	0.50		24.77	22.40	2.37	
9				22.42	24.80		$2.38	22.86	22.45	0.41	
10				20.56	25.55		4.99	21.00	22.40		$1.40
11				19.10	26.40		7.30	19.58	22.30		2.72
12				17.95	27.25		9.30	18.60	22.15		3.55
13				17.00	28.25		11.25	17.94	22.00		4.06
14	$15.82	$31.00	$15.18	16.15	29.20		13.05	17.54	21.80		4.26
15	15.34	32.60	17.26	15.52	30.20		14.68	17.28	21.55		4.27
16	14.95	34.40	19.45	15.07	31.25		16.18	17.06	21.40		4.34
17	14.66	36.40	21.74	14.74	32.30		17.56	16.90	21.25		4.35
18	14.46	38.05	23.59	14.52	33.40		18.88	16.79	21.15		4.36
19	14.34	39.35	25.01	14.45	34.25		19.80	16.68	21.05		4.37
20	14.38	40.00	25.62	14.50	35.15		20.65	16.60	21.00		4.40
21	14.50	40.35	25.85					16.60	20.90		4.30
22	14.69	40.50	25.81					16.65	20.85		4.20
23	14.94	40.55	25.61					16.75	20.80		4.05
24	15.30	40.60	25.30					16.85	20.75		3.90
25	15.78	40.60	24.82								
26	16.11	40.70	24.59								
27	16.45	40.80	24.35								
Weighted average	14.83	36.60	21.77	17.30	28.46		11.16	20.02	22.08		2.06

[1]Excluding federal taxes, severance tax, stumpage, and interest.

enough to make satisfactory growth. In the absence of actual volume distribution figures for a selectively logged area, minimum diameter cutting limits were used and the results are shown in Table 16. Table 16 also shows the method of computing the results. A thorough understanding of how the different cost items are affected if a part of the timber is left uncut is desirable in any discussion of selective logging and is well illustrated in this table. Reference to the table indicates that the production cost decreases until a 21-inch diameter cutting limit is reached, then the rapid increase in permanent improvement costs more than offsets the decreased cost of handling larger timber and an increase in total costs occurs.

The highest return per M board feet would occur if only trees 23 inches and larger were cut. The highest gross return per acre occurs when all trees 11 inches and larger are cut. However, by leaving all trees below 15 inches the gross return per acre would be reduced only $3.75 and nearly a thousand board feet of young timber would be left on the ground for future growth and seed production. This would not be practicable with power skidding. With animal or tractor logging, however, it is entirely practicable to leave a part of the stand to provide a return cut as has already been demonstrated by several companies in the South.

APPLICATION OF RESULTS TO THE HANDLING OF LONGLEAF PINE STANDS

From a profit standpoint based on only one cut and with no interest in the land an operator can use the figures given in this report to determine the minimum diameter cutting limit he should use to obtain the highest return per acre. Under such a plan the condition of the stand influences only one thing, namely, the returns, and the working out of a logging program is simple.

On the other hand, when an owner wishes to remove the stand in two cuts or handle the land so that it will produce a continuous supply of sawlogs the development of a cutting plan becomes more complex. In the first place, present virgin longleaf stands as a rule do not contain a normal distribution of age and size classes, and at the outset cropping plans must cope with understocked areas. Small trees are lacking as are sapling and seedling reproduction. In the stand studied, for example, there were only an average of 9 trees per acre between 9 and 14 inches in diameter but most of them were not distributed over the area but grouped in several small patches as previously mentioned. This situation is characteristic of virgin longleaf stands and it is bound to take a long time to develop a fully stocked well-distributed stand on such areas. Any method of partial cutting must therefore deal with partially stocked stands, particularly so far as young growth is concerned. Where seed is

Table 16.--Gross return[1,2] per thousand board feet, lumber tally, and per acre in cutting to different minimum diameter limits in a typical stand of virgin longleaf pine

Diameter breast high	Volume per acre cut from ths diameter class	Cost per M bd. ft., lumber tally excluding spur cost	Cost per acre excluding spur cost	Sales value per M bd. ft., lumber tally	Sales value of lumber per acre	Diamster breast high for cutting	Total volume per acre removed at the minimum diameter cutting limit	Cumulative cost per acre, excluding spur cost	Cost per M bd. ft., lumber tally excluding spur cost	Spur cost per M bd. ft., lumber tally	Total cost per M bd. ft., lumbsr tally	Cumulative sales value per acre	Salss value per M bd. ft., lumber tally	Gross return per M bd. ft., lumber tally	Gross return per acre
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Inches	Board feet	Dollars	Dollars	Dollars	Dollars	Inches	Board feet	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
9	26	26.11	0.68	22.90	0.60	9 and up	13,137	200.22	15.24	1.28	16.52	417.70	31.80	15.28	200.73
10	66	24.69	1.63	23.60	1.56	10 and up	13,111	199.54	15.22	1.28	16.50	417.10	31.81	15.31	200.73
11	118	22.56	2.66	24.30	2.87	11 and up	13,045	197.91	15.17	1.29	16.46	415.54	31.85	15.39	200.76
12	171	21.32	3.65	25.05	4.28	12 and up	12,927	195.25	15.10	1.30	16.40	412.67	31.92	15.52	200.63
13	223	20.64	4.60	25.75	5.74	13 and up	12,756	191.60	15.02	1.32	16.34	408.39	32.02	15.68	200.01
14	289	19.94	5.76	26.45	7.64	14 and up	12,533	187.00	14.92	1.34	16.26	402.65	32.13	15.87	198.90
15	368	19.26	7.09	27.20	10.01	15 and up	12,244	181.24	14.80	1.37	16.17	395.01	32.26	16.09	197.01
16	473	18.55	8.77	27.95	13.22	16 and up	11,876	174.15	14.66	1.42	16.08	385.00	32.42	16.34	194.05
17	604	17.72	10.70	28.65	17.30	17 and up	11,403	165.38	14.50	1.48	15.98	371.78	32.60	16.62	189.52
18	749	16.97	12.71	29.40	22.02	18 and up	10,799	154.68	14.32	1.56	15.88	354.48	32.83	16.95	183.04
19	933	16.07	14.99	30.10	28.08	19 and up	10,050	141.97	14.13	1.67	15.80	332.46	33.08	17.28	173.66
20	1143	15.32	17.51	30.85	35.26	20 and up	9,117	126.98	13.93	1.84	15.77	304.38	33.39	17.62	160.64
21	1366	14.66	20.03	31.55	43.10	21 and up	7,974	109.47	13.73	2.11	15.84	269.12	33.75	17.91	142.81
22	1406	14.25	20.04	32.30	45.41	22 and up	6,608	89.44	13.54	2.55	16.09	226.02	34.20	18.11	119.67
23	1300	13.95	18.14	33.00	42.90	23 and up	5,202	69.40	13.34	3.23	16.57	180.61	34.72	18.15	94.42
24	1051	13.62	14.31	33.75	35.47	24 and up	3,902	51.26	13.14	4.31	17.45	137.71	35.29	17.84	69.61
25	841	13.43	11.29	34.50	29.01	25 and up	2,851	36.95	12.96	5.90	18.86	102.24	35.86	17.00	48.47
26	644	13.22	8.51	35.20	22.67	26 and up	2,010	25.66	12.77	8.37	21.14	73.23	36.43	15.29	30.73
27	473	12.93	6.12	35.95	17.00	27 and up	1,366	17.15	12.55	12.31	24.86	50.56	37.01	12.15	16.60
28	342	12.68	4.34	36.70	12.55	28 and up	893	11.03	12.35			33.56			
29	236	12.41	2.93	37.45	8.84	29 and up	551	6.69	12.14			21.01			
30	158	12.16	1.92	38.15	6.03	30 and up	315	3.76	11.94			12.17			
31	105	11.80	1.24	38.90	4.08	31 and up	157	1.84	11.72			6.14			
32	39	11.58	0.45	39.45	1.54	32 and up	52	0.60	11.54			2.06			
33	13	11.48	0.15	39.80	0.52	33 and up	13	0.15	11.54			0.52			
Total....	13,137														

[1]Excluding stumpags, federal taxes, and interest.

[2]Msthod of computation:

Column No.	Source of value
2	The volume of timber, per acre, in the corresponding diameter class of column 1, expressed in board feet, lumber tally.
3	The respective totals of Table minus $1.28, the cost of spur tracks, camps, and roads, which varies with the amount of timber cut per acre.
4	Column 2 figures multiplied by the corresponding figures of column 3 and divided by 1000.
5	Valuss from Table 10
6	Column 2 figures multiplied by the corresponding figures of column 5 and divided by 1000.
8	The cumulative totals of column 2 figures, starting with the largest diameter class and cutting all trses of the diameter of the corresponding column 1 figure and larger, expressed in board feet, lumber tally.
9	The cumulative totals of column 4 figure, starting with the largest diameter class and going down to the limit of the corresponding column 1 figure.
10	Column 9 figures divided by the corresponding figures of column 8, whioh were first divided by 1000.
11	The cost of spur tracks and so forth ($16,82 per acre) dividsd in turn by column 8 values, which were first divided by 1000.
12	Column 10 figures plus the corresponding figurss of column 11.
13	The cumulative totals of column 6 figures, starting with the largest diameter class.
14	Column 13 figures divided by the corresponding figures of column 8, which were first divided by 1000.
15	Column 14 figures minus the corresponding figures of column 12.
16	Column 15 figures multiplied by the corrcsponding figures of column 8, which were firet divided by 1000.

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available and fire and hogs are kept out longleaf pine comes up in dense stands, even though it is less tolerant of shade than other southern pines. Probably the most practicable cutting policy to be followed in cases where the company wishes to obtain a return cut would be to take off the present stand in two cuts. For example, if about four-fifths of the present volume were removed, which corresponds roughly to an 18-inch diameter cutting limit, approximately 2,300 board feet of small trees 9 inches in diameter and larger would be left to provide the next cut and seed the land. But for the third cut it is extremely important to seed the land as soon as possible. Such a cutting practice would leave sufficient seed trees to do this. Of course the infrequency of heavy seed years has a bearing on the success of such a plan, but since some seed is borne every year the chances of getting a satisfactory seed crop should not be so hazardous as to preclude the possibility of getting a crop of young trees started.

The gross returns per acre for the first cut would equal about 91 per cent of the total possible return under clear cutting all trees 9 inches and larger. In 20 to 30 years the 2,300 board feet of small and medium-sized trees that were left should increase in size so that between 4,000 and 5,000 board feet could be cut. This cut is sufficient to make logging practicable. If seeding has been successful the area should be well stocked with small trees, and plans for handling the area can be worked out in accordance with the conditions that prevail at the time. In this way the fundamental principle that large trees are cheaper to handle and worth more per M than small ones is taken into account in cutting plans and provision also made for reseeding the land.

SUPPLEMENTARY INFORMATION

Defect

Virgin timber in the South is ordinarily characterized by more or less decay and fire damage. Longleaf pine was found to be no exception, yet the volume of the standing timber actually consumed by fire was surprisingly small whereas the loss from decay was large. Following is a tabulation showing the loss for which a deduction in scaling was made for the logs that were taken to the mill:

Class of Defect	Per Cent
Crook	0.22
Rot, punk, unsound red heart	4.49
Fire	.13
Surface defect - cat face, etc.	.01
Breakage in felling	.05
Total	4.90

The figures show that for all the logs that were taken to the mill the gross scale volume was reduced 4.9 per cent to cover losses in volume due to the causes listed. About 91.6 per cent of the deduction was due to decay, 4.5 per cent to crook, 2.7 per cent to fire, and 1.2 per cent to surface defects and breakage.

In addition to the defective material taken to the mill there were a number of logs and two full trees left in the woods because they were too defective to handle, which means that at least two-thirds of their volume was worthless. If the total volume of these logs and trees is added to the defect found in the logs that were sawed at the mill the total defect in the stand becomes 15.4 per cent. Of this total amount approximately 97 per cent is chargeable to wood-destroying fungi. In addition, there were several partially decayed trees that had been blown down for several years, which indicates that the percentage of defect in the trees, as determined by the study, does not represent the cumulative total for the stand but more nearly a mean average for the standing timber at a given age.

Rot occurred in the butts of the trees and also high up in the bole. Its entrance could not be attributed readily to fire damage except in some of the decayed butts. Broken limbs seem to admit the fungi working in the upper parts of the tree. A few of the trees had been "boxed" a number of years ago to determine their suitability for rail and shake stock. In some instances decay had evidently started and spread from these "box" injuries.

The second-growth trees in this virgin longleaf pine stand were comparatively free from defect of any kind. On the average a deduction of 0.4 per cent for crook and 0.1 per cent for rot were made; there was no appreciable loss due to fire, surface defect, or breakage.

Fire Damage

Table 17 shows the evidence of fire that was found in the stand here reported and in four other stands of southern pine. The virgin shortleaf in the mountains, where debris collects on the uphill side of the trees and where perhaps the intensity of the fire is increased because of the topography, shows evidence of the highest damage. Nearly one-third of all the trees in the mountain stand were fire-scarred and more than one-half of those so damaged contained rot extending from the stump into the first log. Virgin-growth longleaf pine was next in point of fire damage. Approximately one-eighth of the trees were fire-scarred and of these nearly one-half showed rot extending from the stump to the first log. Virgin shortleaf on flat land followed longleaf and showed 9.24 per cent of the trees fire-scarred and nearly a half of them with rot in stump and first log. As might be expected fire damage in the second-growth stands was much less than in the virgin stands and showed that only from 1-1/4 per cent to 2-2/3 per cent of the trees were fire scarred. Of the trees showing fire scars, however, about one-third also showed rot extending from stump into first log.

Growth Rate of Longleaf Pine

As previously stated, there were several patches of young timber on the study area so that in considering growth and age it was necessary to separate the stand into old and young timber. Table 18 shows the average age of the trees in the stand by diameter classes for these two types of timber, also the average number of years that were required by the trees of different sizes to grow an inch in diameter at stump height. For the virgin timber, which was nearly two centuries old, the data show that on the average 9.4 years were required for the trees to growan inch in diameter at the stump as compared to 5.0 years for the second-growth timber of approximately three-fourths century old.

Table 17.--Fire damage in southern pine

Kind of timber	Topography	Per cent of trees free of fire scars	Per cent of trees with fire scars: Grown over	Covering less than 1/3 perimeter of tree or less at stump height	Covering over 1/3 perimeter of tree at stump height	Total	Per cent of fire scarred trees in which the rot extended from stump into first log
Second-growth oldfield loblolly pine	Flat land	97.34	0.53	1.81	0.32	2.66	28.0
Second-growth forest grown shortleaf and loblolly pine	Flat land	98.73	0.09	0.64	0.54	1.27	35.7
Virgin-growth flat land shortleaf pine	Flat land	90.76	0.36	6.57	2.31	9.24	47.3
Virgin-growth shortleaf pine with miscellaneous hardwoods	Mountainous	68.98	6.53	14.97	9.52	31.02	53.1
Virgin-growth longleaf pine	Flat land	86.65	--	8.04	5.31	13.35	45.9

Table 18.--Longleaf pine - average age and years required to grow an inch in diameter for trees of various sizes

Diameter breast high	Virgin-growth timber		Second-growth timber	
	Average age	Time required to grow one inch in diameter at stump height	Average age	Time required to grow one inch in diameter at stump height
Inches	Years	Years	Years	Years
9	---	---	68	7.0
10	---	---	70	6.4
11	158	13.9	71	5.9
12	162	13.0	72	5.5
13	164	12.2	74	5.2
14	168	11.5	76	5.0
15	171	11.0	78	4.8
16	176	10.6	80	4.6
17	181	10.3	83	4.5
18	186	10.0	87	4.5
19	191	9.7	92	4.5
20	196	9.5	97	4.6
21	201	9.3		
22	206	9.1		
23	211	8.9		
24	217	8.8		
25	222	8.6		
26	227	8.5		
27	234	8.4		
28	240	8.3		
29	246	8.2		
30	252	8.2		
31	258	8.1		
32	265	8.0		
Average	198	9.4	76	5.0

Height and Volume of Longleaf Pine

Table 19 gives the average total height and volume actually sawed out in lumber and timbers from longleaf pine trees of different sizes. Volumes ranged from 35 board feet for trees 9 inches in diameter breast high to 1,012 feet for 32-inch trees. Top utilization is also shown and varies from an average of 7 inches for 9-inch trees to 20.7 inches for 32-inch trees. The extreme upper portion of the boles of the virgin timber are covered with large limbs and are not ordinarily taken to the mill for lumber. The length used increases up to 26 inches in diameter and then the length declines slightly. In younger timber the limbs are smaller and it is more practicable to go into the tops to a lower diameter limit.

VALUE OF LONGLEAF PINE LOGS BY POSITIONS

In general, position 1 logs, that is butt logs, are the most valuable even though manufacturing costs are somewhat greater than for position 2, or second, logs of comparable diameters. A knowledge of the value of logs from different positions in the tree is of use in buying logs and in establishing top cutting limits. Tables 20, 21, and 22 give figures for costs, returns, and grade percentages for logs from various positions. Position 1 logs yielded a gross return 21 per cent greater than position 2 logs, position 3 logs were worth only about one-third as much as position 2 logs, and the fourth and fifth cuts in the tree on the average just about paid their way not including stumpage, etc. Quality as indicated by B and Better shows on the average 31.1 per cent of this grade for position 1, 15.5 per cent for position 2, 2.8 per cent for position 3, and 1.2 per cent for positions 4 and 5. The value of the lumber on the average varied from $35.47 per M board feet for all position 1 logs to $20.58 for position 4 and 5 logs.

Methods of Sawing

Methods of sawing have an effect on the grades of lumber obtained and upon overrun. Figure 1 illustrates the methods of sawing that were used and the proportion of the logs that were sawed by each method. Method 1, in which the logs are sawed through and through, does not separate common and clear lumber very well and should not be used where quality is a factor. The figure, however, shows that only the smallest low quality logs were sawed by this method. It is a fast method and saves time in turning at the

Table 19.--Longleaf pine - average height and volume

Diameter breast high	Total height	Length used	Diameter of top log	Volume Doyle gross log scale	Volume lumber tally
Inches	Feet	Feet	Inches	Board feet	Board feet
9	56	27.5	7.0	13	35
10	60	31.0	7.2	24	50
11	64	34.5	7.5	40	75
12	68	38.0	7.9	56	95
13	72	41.0	8.2	79	125
14	76	44.0	8.7	103	155
15	80	47.0	9.1	133	190
16	83	49.5	9.5	172	235
17	86	52.0	10.0	211	280
18	88	54.0	10.6	256	330
19	90	55.0	11.2	306	385
20	92	56.5	11.8	356	440
21	94	57.0	12.5	409	495
22	95	57.5	13.2	468	555
23	96	57.5	13.9	524	610
24	97	57.0	14.6	578	665
25	98	56.5	15.3	628	710
26	99	56.0	16.1	679	757
27	100	55.5	16.8	729	802
28	101	54.5	17.6	779	845
29	102	54.0	18.4	830	888
30	102	53.0	19.2	882	930
31	103	52.5	19.9	933	970
32	103	51.5	20.7	987	1,012
33	104	50.5	21.4	1,042	1,052

Table 20.--Percentage of the total mill output and sales value per thousand board feet, lumber tally, of the various grades sawed from virgin longleaf pine logs of different diameters and positions in a typical woods-run out in southern Louisiana

Top diameter inside bark	Grade in green condition																		Average value per M bd. ft. of green lumber when dry and dressed	
	Boards										Dimension						Timbers			
	B and Better		85 per cent heart		No. 1 Common		No. 2 Common		No. 3 Common		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension					
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Actual	Computed
Inches	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Per cent	Dollars	Dollars	Dollars
Position 1																				
6	10.3	36.67							10.3	10.00	27.6	21.25	24.2	20.00	27.6	12.50			18.96	22.20
7	6.5	38.61			2.5	28.57	16.1	13.44	6.6	10.00	16.9	20.96	2.3	20.00	2.0	12.73	47.1	26.73	22.89	22.95
8	11.5	38.67			3.1	29.50	14.8	13.81	2.7	10.00	6.6	20.70	2.0	20.00	1.7	12.73	57.6	27.98	25.77	23.70
9	14.9	39.10			4.3	30.31	10.6	14.66	5.3	9.15	2.0	20.22	2.3	18.43	1.7	12.43	58.9	25.06	24.97	24.55
10	16.1	39.03	4.2	28.51	8.3	29.78	12.2	14.32	3.7	10.10	3.7	20.50	1.7	18.72	0.9	12.08	49.2	25.47	25.79	25.40
11	23.2	41.45	0.9	30.66	4.5	29.87	12.0	14.52	4.8	10.12	3.9	20.37	3.9	18.46	0.4	11.88	46.4	28.75	28.37	26.40
12	24.9	39.58	5.6	30.48	4.0	30.46	8.5	15.01	3.9	9.21	3.0	20.62	2.4	18.55	1.0	11.96	46.7	29.42	29.34	27.60
13	28.2	39.84	4.8	32.15	5.7	31.86	11.0	15.64	4.6	10.23	3.1	20.51	2.6	18.85	0.4	12.50	39.6	30.15	29.90	29.05
14	30.5	40.99	5.1	34.30	4.2	30.19	8.5	15.82	4.8	10.82	4.3	20.89	1.9	19.32	1.3	12.26	39.4	27.13	29.50	30.80
15	31.2	41.66	3.2	35.00	4.1	31.13	4.8	16.32	2.1	10.87	3.6	22.15	2.5	19.40	1.7	13.41	46.8	26.72	30.42	32.85
16	30.3	42.47	5.1	39.01	4.8	32.50	7.5	17.45	5.0	11.74	3.3	23.60	2.9	20.14	1.1	12.88	40.0	34.61	33.66	35.15
17	33.1	44.46	5.9	39.44	5.8	34.22	6.5	18.26	4.6	11.88	3.9	24.85	4.3	21.18	0.4	12.35	35.5	39.21	36.61	36.95
18	29.2	46.31	3.3	40.78	7.2	33.95	7.8	18.96	7.7	11.32	3.7	26.97	4.1	20.65	1.6	13.33	35.4	44.25	37.39	38.10
19	32.4	48.83	4.0	43.44	5.3	36.19	7.7	18.66	3.6	10.94	4.4	31.94	2.6	22.18	1.2	13.20	38.8	46.40	41.45	39.00
20	35.0	50.02	4.2	49.17	5.3	35.91	7.9	19.59	5.2	11.74	4.3	30.10	2.3	21.72	0.6	13.21	35.2	44.49	41.17	39.70
21	37.4	52.53	8.3	45.03	14.3	40.24	12.2	18.67	7.7	11.75	3.4	28.15	1.5	21.79	0.3	11.88	14.9	48.52	40.87	40.10
22	40.1	51.80	5.6	46.61	8.0	37.81	6.9	19.14	9.2	11.79	2.7	28.24	2.9	21.70	0.6	12.50	24.0	45.30	41.15	40.30
23	33.1	53.15	5.4	50.45	8.8	36.88	9.1	18.93	13.3	12.15	3.8	30.14	1.4	20.63	0.9	13.85	24.2	48.49	40.19	40.40
24	47.6	54.44	10.0	51.46	8.8	35.56	11.0	19.12	10.9	8.86	2.5	30.21	2.9	19.62	1.1	13.00	5.2	51.04	41.38	40.50
25																				40.60
26																				40.70
27	10.8	43.04	31.1	46.06	42.3	41.83	6.4	22.22	5.6	10.00	3.8	21.25							39.46	40.80
Average	31.1	45.92	4.7	40.90	6.1	34.64	8.1	17.52	5.5	11.28	3.8	25.62	2.8	20.52	1.0	12.94	36.9	36.40	35.47	35.47
Position 2																				
6							11.4	13.75	4.3	10.00	24.3	21.18					60.0	26.19	22.86	21.25
7	2.6	37.50	0.8	28.75	0.8	30.00	14.7	13.33	4.3	10.00	7.7	20.85	1.5	20.00			67.6	26.13	23.40	21.95
8	2.6	38.39			1.6	30.00	25.7	13.64	3.0	9.23			1.0	19.05	1.1	12.92	65.0	26.26	22.66	22.75
9	3.2	39.58			1.5	29.70	25.7	14.35	2.6	10.34	5.4	20.33	4.3	18.44			57.3	26.70	22.86	23.65
10	4.2	38.46	3.9	31.18	2.7	29.66	20.4	14.40	2.1	10.00	12.9	20.38	1.9	19.15	0.3	12.73	51.6	28.62	24.58	24.60
11	6.8	38.20	3.4	29.76	2.7	29.71	15.8	14.72	4.0	11.01	8.5	20.54	4.2	19.10	2.5	11.96	52.1	30.63	25.98	25.60
12	9.4	38.82	3.2	28.87	4.5	31.22	15.3	15.22	5.1	11.18	6.5	20.51	6.3	19.23	2.3	12.18	47.4	31.35	26.56	26.70
13	12.7	39.14	4.1	30.24	4.0	30.90	11.7	16.21	5.6	11.10	10.8	20.36	7.3	19.30	2.3	12.20	41.5	33.82	27.89	28.15
14	15.9	39.69	4.7	33.34	3.0	29.90	10.8	15.85	6.0	11.24	10.6	22.39	4.0	20.61	1.5	12.72	43.5	32.50	28.69	30.05
15	18.8	41.92	8.2	41.49	3.7	31.47	7.7	17.25	4.1	11.85	7.9	24.83	6.8	21.27	2.1	13.33	40.7	37.44	33.19	32.20
16	18.2	42.23	13.6	41.54	3.2	33.46	8.0	17.37	6.6	11.21	8.2	24.94	6.8	21.71	1.1	13.39	34.3	36.84	32.84	34.00
17	19.1	42.53	14.4	42.56	2.9	32.75	10.3	18.38	6.4	12.35	8.3	27.02	3.3	22.91	2.3	13.32	33.0	46.02	36.38	35.05
18	20.5	43.82	10.6	45.08	3.6	36.49	11.0	22.25	8.3	12.91	4.7	29.78	6.0	22.40	1.1	13.61	34.2	48.01	37.91	35.70
19	14.8	42.56	3.5	40.20	3.8	35.84	11.1	20.85	9.5	12.96	6.4	30.30	7.1	22.46	1.7	13.75	42.1	44.53	35.13	36.10
20	21.7	46.43	2.0	38.99	2.6	35.91	12.5	21.72	1.7	12.63	4.4	29.21	5.9	22.28	1.5	12.31	47.7	43.92	38.45	36.30
21	4.0	37.78			9.2	32.10	25.1	21.12	49.9	12.84			4.1	23.57	7.7	14.04			18.22	36.50
22	22.8	49.15	5.5	39.59	2.7	32.46	18.4	22.61	11.9	12.40	3.0	31.21	8.0	22.84	0.5	12.73	27.2	48.50	35.92	36.65
23																				36.75
Average	15.5	42.38	7.3	40.16	3.3	32.34	11.9	17.27	6.1	11.80	7.8	23.98	5.5	21.14	1.7	12.95	40.9	36.49	31.52	31.52

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Table 21.--Psroentage of the total mill output and sales value per thousand board feet, lumber tally, of the various grades sawed from virgin longleaf pine logs of different diameters and positions in a typioal woods-run out in southern Louisiana

Top diameter inside bark	Grade in green condition																		Average value per M bd. ft. of green lumber whsn dry and dresssd	
	Boards										Dimension						Timbers			
	B and Better		85 per cent heart		No. 1 Common		No. 2 Common		No. 3 Common		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension					
	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Value	Amount	Valus	Amount	Value	Actual	*Computed*
Inches	Per oent	Dollars	Per cent	Dollars	Per oent	Dollars	Per oent	Dollars	Per cent	Dollars	Per oent	Dollars	Per cent	Dollars	Per oent	Dollars	Per cent	Dollars	Dollars	Dollars
								Position 3												
6							17.0	13.33			62.3	21.52	20.7	20.00					19.81	21.25
7	0.4	36.67			0.4	30.00	25.8	13.54	5.5	10.23	1.5	20.00	4.3	18.82			62.1	27.64	22.60	21.70
8	1.2	37.50			0.6	30.00	24.4	13.60	5.9	9.91	1.6	20.00	3.0	18.28	2.5	12.00	60.8	26.59	21.87	21.95
9	0.8	40.00	1.3	27.65	1.3	30.00	22.4	14.29	7.4	9.79	7.6	20.56	6.5	18.70	3.1	12.24	49.6	28.10	22.09	22.15
10	0.5	37.86	0.4	28.00	0.4	30.00	20.2	14.46	7.3	10.00	15.7	20.30	11.9	18.77	0.3	12.50	43.3	30.36	22.58	22.30
11	1.7	37.18	0.8	28.75	0.8	29.71	17.8	14.51	7.4	11.07	12.0	20.32	13.5	18.80	3.0	12.02	43.0	30.08	22.77	22.50
12	1.6	36.83	5.2	30.74	2.0	30.50	18.5	14.95	7.2	10.64	11.3	20.39	12.0	19.38	2.0	12.19	40.2	29.85	23.20	22.85
13	3.4	39.49	2.4	28.50	1.1	29.68	17.6	15.54	9.2	10.49	12.9	21.47	18.0	19.13	2.3	12.26	33.1	29.82	22.42	23.45
14	4.5	37.83	8.0	32.88	1.6	30.51	14.8	15.84	14.0	11.16	8.8	22.78	15.3	20.52	7.1	12.86	25.9	34.23	23.65	24.20
15	3.5	37.79	14.9	37.41	2.6	30.60	18.2	15.88	10.5	11.57	10.5	23.05	10.5	20.15	1.4	12.89	27.9	35.37	26.38	24.70
16	4.5	39.47	10.4	38.37	2.1	31.55	12.2	16.47	18.3	11.44	15.3	25.71	19.5	21.58	4.0	13.36	13.7	38.57	24.49	25.05
17	5.0	43.30	20.0	45.40	1.0	31.67	12.7	16.42	7.8	11.91	18.9	24.61	15.7	22.96	12.4	13.90	6.5	27.69	26.36	25.30
18	7.4	41.18			2.9	36.92	26.7	18.69	39.8	11.43	7.9	31.11	5.0	21.30	10.3	12.77			18.50	25.45
19	1.5	37.50					23.1	16.29	60.5	13.52			14.9	23.75					16.04	25.55
20	0.6	25.00	42.4	45.97			2.6	15.56	2.6	11.11	37.4	29.53	10.6	23.61	3.8	12.31			34.35	25.65
21																				25.70
Average	2.8	38.76	6.4	37.38	1.4	30.76	17.7	15.22	10.5	11.04	11.3	22.36	13.1	20.00	3.6	12.81	33.2	30.58	23.52	23.51
								Positions 4 and 5 combined												
8	1.1	25.00			5.7	30.00	21.3	13.51	2.9	10.00							69.0	29.25	25.34	19.25
9	0.5	37.50	7.2	28.75	0.5	30.00	21.5	14.13	19.0	10.14	4.1	20.63	15.4	18.50	5.2	12.00	26.6	26.62	18.77	19.60
10	1.0	35.38	1.1	27.86			19.4	14.45	16.5	9.54	8.2	20.19	16.5	18.43	7.5	12.02	29.8	27.18	18.74	19.90
11	0.5	37.69	3.9	28.50	0.1	30.00	10.2	15.10	15.1	10.08	15.4	20.24	25.5	18.54	3.3	12.03	26.0	28.37	20.01	20.25
12	1.2	32.80	5.7	28.70	0.4	30.00	8.3	14.35	18.6	9.79	10.7	20.50	20.8	18.63	3.1	12.03	31.2	30.33	21.07	20.60
13	1.1	35.00			0.8	32.22	17.9	15.72	9.1	9.80			19.6	20.46	2.6	12.07	48.9	26.89	21.82	20.95
14	2.2	36.77	14.4	32.52	1.3	29.27	12.9	15.19	15.3	9.95	20.6	24.01	22.5	20.75	5.6	13.19	5.2	42.70	21.93	21.30
15	1.9	35.00	3.8	45.83	0.3	30.00	21.1	15.92	21.0	11.40	5.1	22.92	36.9	21.62	3.2	13.00	6.7	32.03	19.96	21.70
16			18.5	46.00					2.8	10.00	12.0	20.77	66.7	22.08					26.01	22.10
Average	1.2	35.37	5.2	31.89	0.6	30.18	14.2	14.96	15.8	10.07	10.5	21.45	22.6	19.60	4.1	12.30	25.8	28.75	20.58	20.58

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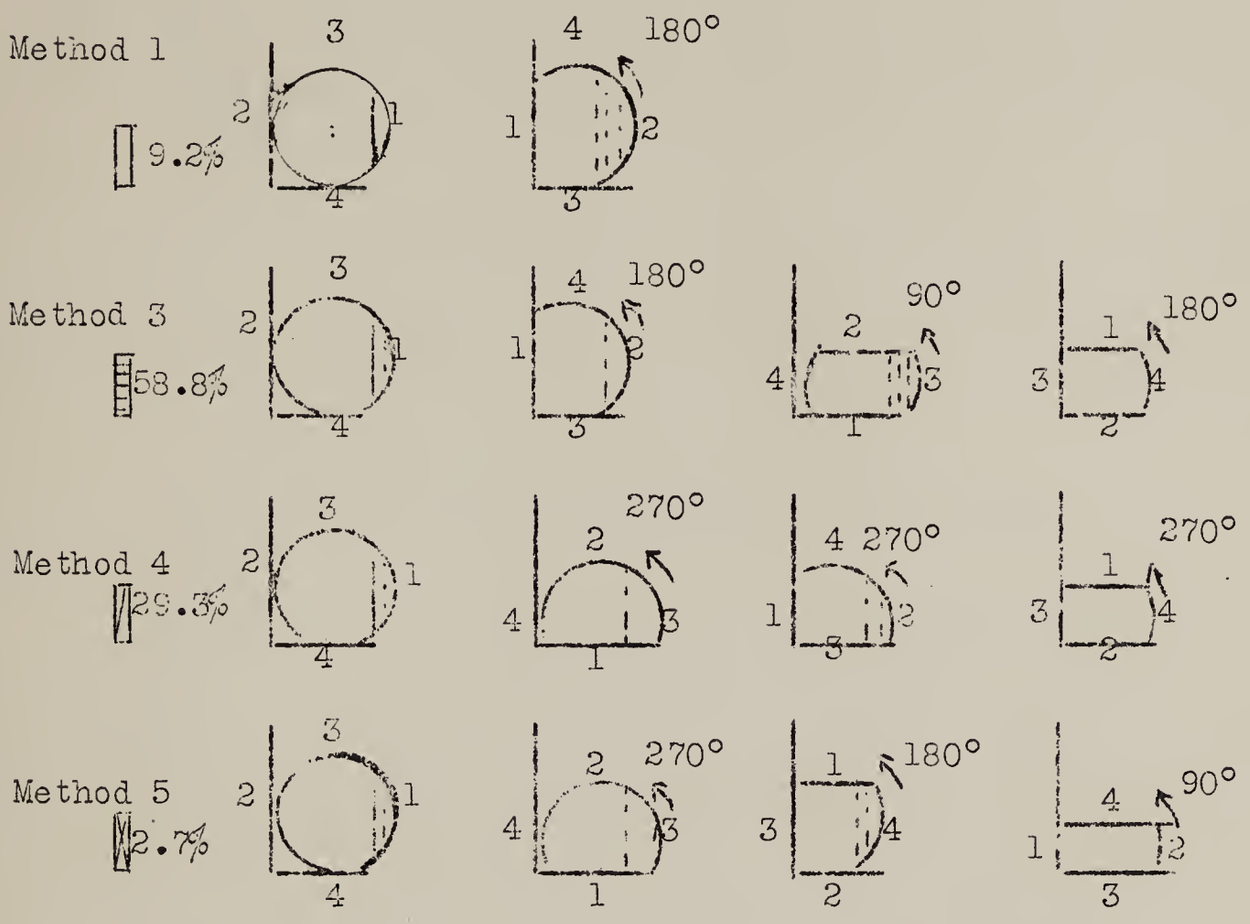
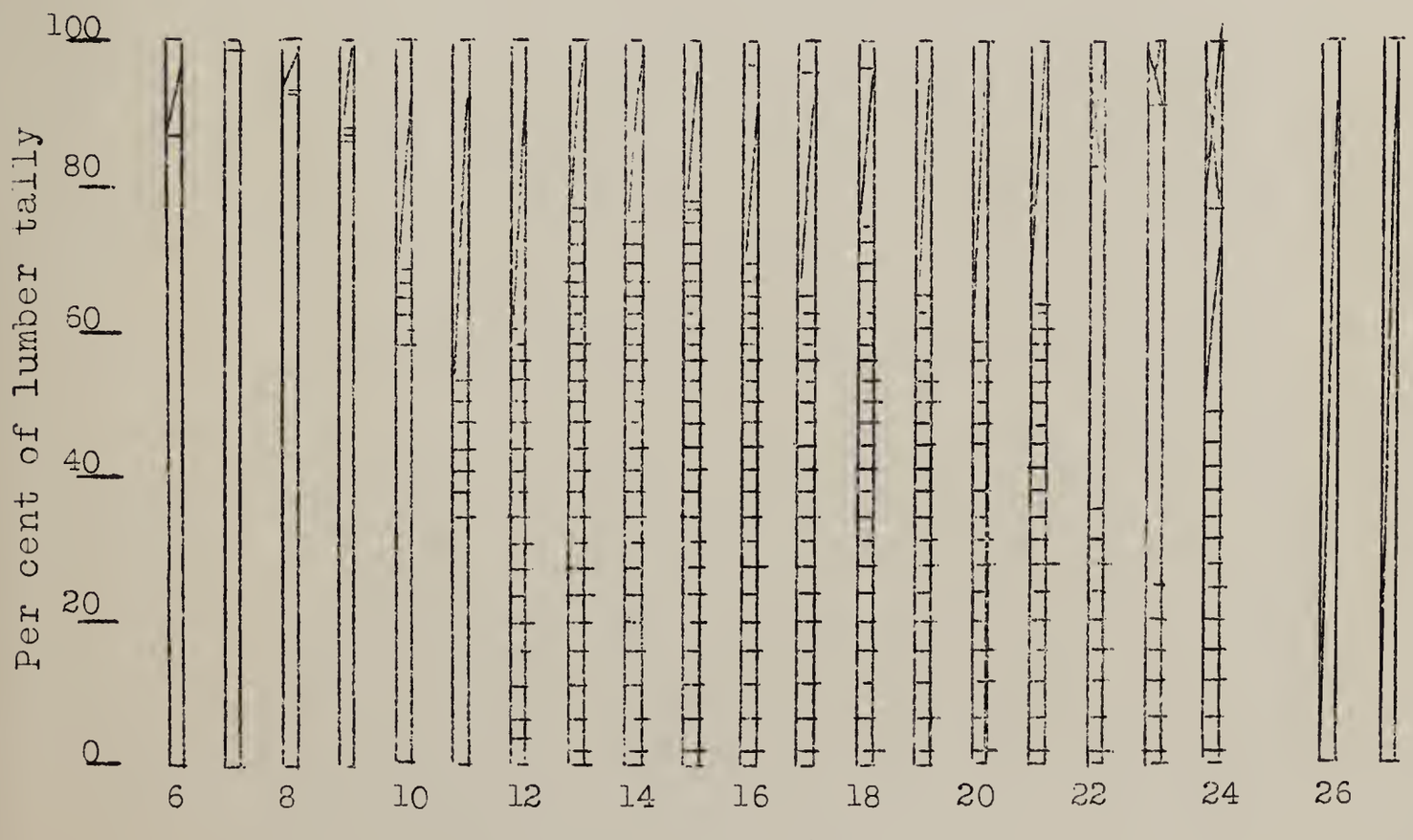
Table 22.--Difference between production cost and value of lumber for virgin longleaf pine logs of different diameters by positions

Top diameter inside bark	Position 1				Position 2				Position 3				Positions 4 and 5			
	Total lumber production cost	Value of lumber	Difference[1]		Total lumber production cost	Value of lumber	Difference[1]		Total lumber production cost	Value of lumber	Difference[1]		Total lumber production cost	Value of lumber	Difference[1]	
			Loss	Gain			Loss	Gain			Loss	Gain			Loss	Gain
	Per thousand feet lumber tally															
Inches																
6	$36.30	$22.20	$14.10		$29.80	$21.25	$ 8.55		$31.60	$21.25	$10.35					
7	30.50	22.95	7.55		26.40	21.95	4.45		27.40	21.70	5.70		$32.10	$18.95	$13.15	
8	26.10	23.70	2.40		24.30	22.75	1.55		24.30	21.95	2.35		28.30	19.25	9.05	
9	23.25	24.55		$ 1.30	22.45	23.65		$ 1.20	22.15	22.15	0.0		25.15	19.60	5.55	
10	21.20	25.40		4.20	20.70	24.60		3.90	20.45	22.30		$ 1.85	22.85	19.90	2.95	
11	19.60	26.40		6.80	19.15	25.60		6.45	19.15	22.50		3.35	21.05	20.25	0.80	
12	18.40	27.60		9.20	17.70	26.70		9.00	17.95	22.85		4.90	19.70	20.60		$ 0.90
13	17.45	29.05		11.60	16.50	28.15		11.65	17.20	23.45		6.25	18.65	20.95		2.30
14	16.75	30.80		14.05	15.50	30.05		14.55	16.60	24.20		7.60	17.95	21.30		3.35
15	16.20	32.85		16.65	14.55	32.20		17.65	16.20	24.70		8.50	17.45	21.70		4.25
16	15.85	35.15		19.30	13.90	34.00		20.10	15.85	25.05		9.20	17.10	22.10		5.00
17	15.50	36.95		21.45	13.50	35.05		21.55	15.60	25.30		9.70				
18	15.30	38.10		22.80	13.30	35.70		22.40	15.35	25.45		10.10				
19	15.15	39.00		23.85	13.25	36.10		22.85	15.15	25.55		10.40				
20	15.05	39.70		24.65	13.30	36.30		23.00	14.95	25.65		10.70				
21	15.00	40.10		25.10	13.45	36.50		23.05	14.85	25.70		10.85				
22	15.05	40.30		25.25	13.65	36.65		23.00								
23	15.15	40.40		25.25	13.90	36.75		22.85								
24	15.39	40.50		25.11												
25	15.78	40.60		24.82												
26	16.11	40.70		24.59												
27	16.45	40.80		24.35												
Weighted average	16.20	35.47		19.27	15.54	31.52		15.98	18.20	23.51		5.31	20.40	20.58		0.18

[1] Excluding federal taxes, severance tax, stumpage, and interest.

Fig. 1.--Methods of sawing logs, and percentages of the total lumber tally sawed by each method. Also, percentages by each method within diameters.





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headsaw. Method 3 was used to cut nearly three-fifths of the logs and is a natural and efficient way of sawing logs to get the largest proportion of the high grade lumber that they contain. Method 4, in which the log is likewise turned three times, is also a good method for certain types of logs, but in most mills is used less than was the case at the mill studied.

Method 5 is used only where it is desired to saw a certain face of the log at a given time. The log does not set naturally in the third position andmust be dogged extremely tight or slips occur which result in miscut lumber.

Comparative Quality and Value of Second-Growth and Virgin-Growth Longleaf Pine

As previously noted most virgin longleaf stands have small patches of young timber scattered through them. These young stands under clear cutting are logged along with the old timber. Other things being equal, as between old and young timber of the same size, the old timber is of higher quality. Table 23 brings out this point and shows that the virgin timber was worth $1.66 more per M board feet than the second-growth timber. This is a smaller spread than would be the case if the timber were all cut into lumber. In this study three-fifths of the young timber was sawed into timbers, which have a higher price than the lumber they would saw out, and only two-fifths of the old timber, but the old timber had a higher value which partially offsets the difference. A greater amount of B and Better and the 85 per cent heart from the old timber largely account for its higher value as compared to the young timber. In making these comparisons the same volume distribution among the different diameter classes was used for both kinds of timber.

Thickness of Lumber and Sawing Variation

Table 24 shows the average thickness obtained at the mill studied for lumber of different thicknesses. For example, 4/4 lumber varied from 7/8 inch to 1-5/16 inches in thickness and averaged 1-5/32 inches. About one-third of the 4/4 material was 1-1/8 inches thick, about one-half was thicker, and nearly one-fourth was thinner than this average. Allowing 4/32 for surfacing and 2/32 for shrinkage a board must have a minimum thickness of 31/32 of an inch in the green condition if it is to dress out to the American Lumber Standard of 25/32 of an inch when dry. The average thickness in this study

Table 23.--Comparison of quality and value of second-growth and virgin-growth longleaf pine timber[1]

Grade	Second-growth timber Less than 100 years old		Virgin-growth timber Over 100 years old	
	Proportion of different grades of lumber	Value of lumber per M board feet	Proportion of different grades of lumber	Value of lumber per M board feet
	Per cent	Dollars	Per cent	Dollars
B and Better	12.1	39.04	16.1	39.98
No. 1 85 per cent heart	--	--	2.5	31.92
No. 1 Common	3.7	30.14	3.4	30.09
No. 2 Common	15.7	14.36	12.6	14.56
No. 3 Common	2.4	9.90	5.9	10.27
No. 1 Dimension	4.8	20.60	5.3	20.87
No. 2 Dimension	0.8	18.99	6.0	18.91
No. 3 Dimension	0.2	12.43	3.4	12.63
Timbers	60.3	26.09	44.8	30.18
Weighted average	--	25.23		26.89

[1]Same size and volume used in each case.

Table 24.--Average thickness of lumber and sawing variation

4/4 inch lumber		5/4 inch lumber		6/4 inch lumber		8/4 inch lumber	
Thickness	Per cent	Thickness	Per cent	Thickness	Per cent	Thickness	Per cent
Inches		Inches		Inches		Inches	
7/8	0.7	1-1/4	0	1-1/2	3.0	1-29/32	2.7
1	1.4	1-9/32	2.9	1-17/32	---	1-31/32	2.7
1-1/32	1.4	1-5/16	5.9	1-9/16	---	2	10.8
1-1/16	8.2	1-11/32	5.9	1-19/32	3.0	2-1/32	2.7
1-3/32	10.3	1-3/8	38.2	1-5/8	45.5	2-1/16	8.1
1-1/8	32.8	1-13/32	17.7	1-21/32	27.3	2-3/32	2.7
1-5/32	14.4	1-7/16	17.7	1-11/16	15.2	2-1/8	27.1
1-3/16	13.7	1-15/32	8.8	1-23/32	3.0	2-5/32	18.9
1-7/32	10.9	1-1/2	---	1-3/4	3.0	2-3/16	8.1
1-1/4	4.8	1-17/32	2.9			2-7/32	5.4
1-9/32	0.7					2-1/4	5.4
1-5/16	0.7					2-9/32	2.7
						2-5/16	2.7
Av. thickness 1-5/32 inches		Av. thickness 1-13/32 inches		Av. thickness 1-21/32 inches		Av. thickness 2-4/32 inches	

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was 37/32 inches or 6/32 of an inch thicker than required to meet the above specification. With the sawing variation and thickness standard found at this mill, 97.9 per cent of the material should dress out, which is a high figure. In other mills that were studied the average thickness was about 35/32 inches. In such mills about 95 per cent of the material would dress to 25/32 of an inch thick. The loss in this case, however, is less than that which occurs where lumber is cut unnecessarily thick.

A similar analysis could be made of the other thicknesses. The widest variation in thickness occurred in the 8/4 material and the narrowest in the 6/4. Material 5/4-inch thick averaged 1-13/32 inches thick, 6/4 material 1-21/32 inches thick, and 8/4 stock 2-4/32 inches thick. For yard lumber these thicknesses appear to be greater than is necessary. On the other hand, some of the lumber was sold in foreign markets where a full inch in thickness in the rough is desired, which can be accepted as justification for the sawing practice.

Width of Lumber and Sawing Variation

Table 25 gives the average width for each width into which the lumber was cut and the variation from this average. On the average, 4-inch board were 4-6/16 inches wide, 6-inch boards 6-1/2 inches, 8-inch boards 8-1/2 inches, and 12-inch boards 12-3/4 inches. In each width a greater amount was allowed to cover shrinkage and ripping than was the case in several other studies in shortleaf pine. Even considering the fact that longleafpine may shrink more than the other southern pines the allowance seems more than is absolutely required. With the green width as cut there should be practically no "fall down" because boards do not "make" on the edge and there is a considerable amount dressed off on most of the boards. For example, dry and dressed 4-inch boards must be 3-5/8 inches wide, but on the average the 4-inch rough stock was 4-3/8 inches wide which gives an allowance of 3/4 of an inch for shrinkage and dressing, or about twice as much as is actually required. It is recognized, of course, that most of the 4-inch boards come from narrow faced flitches and that there is nothing saved even if the stock is cut with less allowance. Excess sizes for green stock, however, are a source of loss and must be guarded against if the most lumber is to be obtained from a given run of logs.

Table 25.--Average width and variation in sawing

Sixteenth of inch in excess of normal width	4-inch width	6-inch width	8-inch width	10-inch width	12-inch width
	Per cent	Per cent	Per cent	Per cent	Per cent
0	2.4		2.5		
1	---				
2	4.8			2.6	
3	4.8				
4	7.1	4.3	2.5	2.6	
5	4.8	2.2	5.0	10.2	
6	23.8	34.8	2.5	5.1	
7	16.6	6.5	7.5	10.2	7.9
8	28.5	21.8	35.0	30.8	5.3
9	2.4	2.2	10.0	10.3	10.5
10	4.8	17.4	22.5	10.2	10.5
11				10.2	10.5
12		6.5	10.0	2.6	---
13				2.6	5.3
14		4.3	2.5	2.6	21.1
15					10.5
16					15.8
17					---
18					2.6
Average width inches	4-6/16	6-1/2	8-1/2	10-1/2	12-3/4

SUMMARY

Although the figures and facts obtained in this study apply directly only to the operation that was studied, the cost ratios, overrun, grade percentages, and trends established by the data have general application in all virgin longleaf pine stands. Such stands are ordinarily lacking in young timber and for this reason the handling of such areas for successive cuts by selective cutting will offer some difficulties until the proper distribution of growing stock is obtained.

Nevertheless, the fundamental principle that small trees are more costly to handle and yield lower quality lumber than large trees has an important application in managing such stands.

Following are some of the points brought out by the study:

1. Total production costs were 1.7 times greater for 10-inch trees than for 24-inch trees even though approximately 60 per cent of the volume of the small trees were cut into timber and only 40 per cent of the larger ones.

2. The value of the lumber and timbers for 10-inch trees was $23.60 as compared with $33.75 per M for 24-inch trees.

3. The highest return per acre under clear cutting could be obtained by cutting only trees 11 inches and larger not considering the cost of stumpage, federal taxes, or interest. If only trees 13 inches and larger in diameter were cut, within 75 cents of the same total return would be obtained. This is the cutting limit that would appeal to an operator interested in one cut only.

4. Computation shows that the highest return per M board feet would be obtained by cutting only trees 23 inches in diameter and larger, provided the mill had sufficient supply of timber to keep it running. This is the limit that should be considered in a selective logging plan. However, financial considerations usually preclude the following of this limit and a lower cutting limit which will remove from one-half to two-thirds of the volume is deemed best.

5. If a charge of $4.50 per M for stumpage and $2.00 for profit is added to the production costs, then, on the average, trees had to be 15 inches in diameter to pay out. Without these charges the minimum diameter of a tree that pays just the production costs was 11 inches. For logs, the profitable point, not considering stumpage or profit, came at 9 inches. With stumpage and a reasonable profit assumed, computation showed that 11 to 12-inch logs were the smallest that could be handled.

In a consideration of these minimum diameter cutting limits, or any others applying to logs and trees, it must be kept in mind that there is a vast difference in potential value between small logs from small thrifty trees and small logs from the tops of large trees. Small thrifty trees are valuable as growing stock and can be left uncut, thus reducing the number of small logs that must be handled. Small logs from the tops of large trees, however, are of no value unless utilized at a profit. It is usually considered good business to bring in those small and poor quality logs that yield a return if not charged with felling, stumpage, railroad, camp, and permanent construction of all kinds. This policy is based on the fact that all such improvements and other costs were necessary for the handling of the better part of the stand. For example, the larger trees had to be felled to get the high quality logs and the top logs came down with them with no additional cost, so felling need not be charged against them. This method of cost accounting makes it possible to reduce by about two inches the minimum size of log that can be handled. The same method of accounting might be used for small trees, except for the fact that they have a value as growing stock, whereas the small logs from large trees have no value unless a method of utilizing them immediately can be worked out.

6. Selecting the trees to be cut as shown by the data in this report influences markedly the profits to be made on the material handled. In addition, the leaving of the small trees makes possible an earlier second cut and may prolong the life of the operation. Selective cutting is, therefore, designed to reduce cost and to increase the quality of the material handled. If through selective cutting, operations can be made permanent then all the advantages of cheaper stumpage, better social and business conditions, and the like, will follow.

7. Overrun averaged 21.9 per cent and ranged from 112.0 per cent for 10-inch trees to 11.5 per cent for 26-inch trees.

8. Defect amounted to 15.4 per cent for the standing timber. About 97 per cent of this was due to decay.

9. Thirteen per cent of all trees in the stand were fire scarred. Forty-six per cent of these contained rot which extended from the stump into the first log.

10. The virgin timber in the stand had grown at an average rate, as measured by a ring count on the stump, of one inch in 9.4 years and second-growth timber at an average rate of one inch in 5 years.

11. On the average second-growth longleaf pine was worth $1.65 less per M board feet than virgin-growth timber of comparable size.